VOLUNTEER MONITORING FIELD PROCEDURES

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FIELD PROCEDURE: KNOW BEFORE YOU GO: GUIDELINES FOR QUARTERLY MONITORING

TAKING CARE OF YOURSELVES:

- **Safety first**! Nothing is more important. Don't go out alone, and make sure somebody knows where you're going and when you expect to be back. Cell phones are handy but not always reliable.
- **Liability**: Be careful not to trespass. We have permission to monitor at all of our regular sites, but that does not give you the right to walk the length of the stream. A copy of the landowner permission letter obtained by Clark County for your site will be included in your monitoring kit.
- **Orientation**: If you don't know the area, take a good map like the Clark County atlas with you. One is included in the monitoring kit.
- **Warm-up**: Stretch before stream walking, especially quadriceps, calves and hamstrings. If you're limber, you'll find it easier to move when faced with sudden loss of footing.
- **Awareness**: Keep your eyes moving as you walk. Don't just fixate on the section of stream you are currently encountering. Scan the stream in front of you and try to be as proactive as possible when picking your route. (Note that jacket hoods block peripheral vision and ball-cap bills block hazards overhead.) Many creatures utilize the riparian corridor, so be conscious of your body placement and what wildlife is around you as you rest or write.
- **Walking**: Boots with felt bottoms or corkers are the safest. Hip boots and wading shoes do not offer much support, so if you have weak ankles, wrap them for stability. Walking sticks have numerous uses: third leg, water depth/substrate tester, brush whacker, balancing aid. Polarized glasses will help you see the creek bottom.
- **Fatigue**: Note your energy level and those of your teammates. Know when to quit.
- **High water**: Avoid walking in streams when water depth is above mid thigh, especially in faster flows. In higher flow situations, plan your stream crossings at an angle, allowing the water to "carry" you to your destination. If the creek is raging and you can't wade across, don't go in! You can do many of the field procedures from the bank, and the rest can wait until the next session.
- **Log jams**: All log jams, no mater how small, have the potential to cause injury – avoid them if possible. If you have to walk on them, choose the most stable and safe parts. Beware of bare logs or alders, which are slippery and may be rotten. Make sure your footing is on a stable log before resting all your weight on it. Attempt to have an escape plan if a particular log shifts. Avoid pulling yourself up via attached branches.
- **Hazardous materials**: The most dangerous materials we use are alcohol and glass cleaner (which you will hear about during volunteer orientation), but you may find other hazardous materials at your sites – broken glass, needles, human/animal wastes, etc.
- **Weather gear**: Be prepared for rain, wind, and cold. For cold, bring a thermos or a St. Bernard, plus extra layers of clothing, rain gear, and a warm hat (remember – you lose 75% of your body heat through your head). For heat, bring a hat, sunblock, and plenty to drink. For brush and biting insects, long pants and sleeves are good.
- **Rain**: If it begins to rain heavily, thunder, lightning, or hail, get out of the stream and into your car. If it seems to be a passing storm, try waiting it out and then returning to the stream. Note on

your field form the time you left and returned, and about how much rain fell, keep an eye on water levels if it has been raining anywhere in the watershed.

- **Dogs**: Use your best judgment if a menacing dog comes your way. Running is not the best reaction. Talk to the dog calmly, and call for the owner.
- **Bees and other allergies**: Bees may nest along stream banks, in the ground, and in hives in the trees. Watch for nests or "sentinel" bees around nests. If you see bees, avoid them and notify your teammates. If you are allergic to bees, always carry your prescribed bee kit with you. Never leave it in the car. County first aide kits do not include bee sting kits.
- **Brush**: Some parts of the stream may be very brushy or worse. Help each other to avoid getting tangles or prickled, and work around what you have to.
- **Neighborliness**: Where we do have permission to access private property, remember that we are guests and ambassadors for the program. When you see people out in the field, wave and say hello. Chat, but remember that you can't chat too much or you won't be able to accomplish your mission.

CARING FOR THE CRITTERS:

All streams support a large array of interconnected communities – from fish to invertebrates to lower organisms such as algae. Walking in a stream will cause some disruption to these links. The key is to be aware and minimize any damage. If possible, walk along the banks (this includes exuberant canine companions!). When you have to walk in the stream channel be aware of your travel path. Many times of the year, especially fall through spring, some type of salmonid spawning activity could be taking place in a stream.

After spawning, salmonid eggs will develop at different rates depending on water temperature. Detection of developing eggs under a blanket of gravel can be a challenge. Chinook and coho build classic redds that look like pockets (pits) in the gravel with mounds (tailouts) of clean gravel behind them. The eggs are in the tailouts, which can extend 1-2.5 meters downstream. Salmon that spawn en masse, such as pinks and chums, tend not to build redds that are distinctive other than cleaned gravel. Also, high flows can smooth out the contours on these sites. Knowledge of substrate size, spawning location, and spawning characteristics of salmonid species may help minimize potential damage. The following is a generalized chart describing some salmonid redds:

SPECIES	SPAWNING GRAVEL SIZE	REDD LOCATION	SPAWINING CHARACTERISTICS
Chinook	Cobble (tennis ball to basketball size)	Mainstem rivers and lower tribs	Distinct Redds
Coho	Small-Mid	Side channels, tribs, margins or rivers	Distinct Redds
Steelhead	Small-Mid	Mainstem and tribs	Distinct redds or nests (small redds)
Cutthroat	Small	Tribs and small streams	Mini redds

QUARTERLY MONITORING SEQUENCE:

- Arrange monitoring dates with your team and reserve a field kit—the earlier the better!
- Inventory the field kits for completeness before taking them out.
- Visit reaches from downstream to upstream. This allows for better comparison of temperature data taken at different times of the day if you are monitoring multiple reaches.
- At a given reach, begin with fish and wildlife observations – you're most likely to see things before you've mucked around very much.
- Update your reach map as needed, preferably with a pencil; initial and date any changes you make; and describe these changes on your field data sheet. Along with a note for staff to recopy the updated reach map for the office file. If the changes in the reach are substantial, plan a day with your team to redraw the reach map (hopefully using the same baseline and dimensions).
- Turn in your equipment on time. **Remember to**:
  - Leave equipment out to dry if you're storing it at home for a period.
  - Check in your field kits.
  - Leave notes for staff if equipment needs maintenance, replacement, or calibration.
  - Notify the coordinator of volunteer hours, if applicable.
  - Check over all field sheets for completeness and clarity before turning them in.

GROUND RULES FOR MONITORING:

- Follow the written protocols. They are the keys to data credibility. If you're getting tired and sloppy, go home – incomplete data is far better than junk data.
- Take field notes. Include weather observations, appearance of the reach or water, equipment problems or substitutions, any modifications to the written protocols.
- When signing in at the top of a data sheet, include all initials plus your last name. When you initial data entries, include all of your initials.
- Always take water chemistry and grab samples in the thalweg (the deepest part of the channel) unless it puts you in danger, and be sure to do all chemical tests and take macroinvertebrate samples upstream of any places where you have walked in the creek.

RECORDING DATA:

- Fill in all blanks on the data sheets. Write Legibly.
- For any procedure, one sampler should initial the data sheet. This is the sampler who takes responsibility for the data. If more than one person sampled that parameter together, the person with the most experience will usually initial the data.

NUMBER ROUNDING CONVENTION (From the Clallam County Streamkeeper's Manual):

Your protocols and field sheets will tell you how many decimal places to include when you record numbers. Often, our instruments will give more decimal places than you are supposed to record. **Please only record the number of decimal places asked for in the protocol or on the datasheet – if you record more decimal places, you'll cause problems for the volunteers who do data-entry.** Follow the procedures below for rounding numbers:

1. If the figure beyond the last figure to be retained i+s less than 5, do not change the last figure to be retained. Example: rounding 34.44 to the nearest tenth gives 34.4.
2. If the figure beyond the last figure to be retained is greater than 5, then increase the last figure to be retained by 1. Example: rounding 55.67 to the nearest tenth give 55.7.

3. If the figure beyond the last figure to be retained is 5 (followed by zeroes or with no following figures)…
   a) keep the last figure to be retained if it is even, or
   b) increase the last figure to be retained if it is odd.
   Example: rounding 43.55 to the nearest tenth gives 43.6. Rounding 67.85 to the nearest tenth gives 67.8.
4. If the figure beyond the last figure to be retained is 5, followed by figures other than zeroes, regard the "5" as really greater than 5 and use Rule2 above. Example: rounding 6.451 to the nearest tenth gives 6.5.

See examples of rounding convention below:

This number…	…when rounded to this many decimal places…	…rounds to this number
43.64	0.1 (nearest tenth)	43.6
43.66	0.1 (nearest tenth)	43.7
43.65	0.1 (nearest tenth)	43.6
43.75	0.1 (nearest tenth)	43.7
43.85	0.1 (nearest tenth)	43.8
43.851	0.1 (nearest tenth)	43.9
43.855	0.1 (nearest tenth)	43.9
43.855	0.01 (nearest hundredth)	43.86
43.995	0.01 (nearest hundredth)	44.00

REACH ESTABLISHMENT

MONITORING SITE SELECTION

Background

Clark County staff selected the original stream-sample sites in this project. The county's Water Resources Section identified sites that added-on to existing monitoring efforts intended to describe and follow long-term trends in stream health of Clark County. These volunteer sites not only expand the county's ongoing effort, but also allow the placement of sites *within* watersheds to help describe how streams change as they flow over the land.

From the original list, sites were chosen based on these criteria: 1) where data would support existing projects; 2) that were easily accessible by volunteers; 3) that allowed enough stream distance to perform the procedures; 4) where stream access was secured from private landowners; and, 5) that represented diverse land uses.

The county's monitoring resource center provides equipment and guides the efforts of the Clark County Watershed Stewards in monitoring these sites. In the near future, the program will expand to include sites of interest to volunteers outside the Watershed Stewards. This may include outdoor clubs, neighborhood associations, business associations, conservation groups, and cooperating agencies.

Establishing a new site

If you are interested in monitoring a particular site or stream that is not on this year's volunteer workscope, we suggest you do the following:

- Join an existing team for the remainder of the year. This way you will receive the training and learn our protocols. You can tell County staff which of the existing teams you'd like to join, or staff can assign you to a team.

- Do the homework necessary to determine the value of monitoring the new stream or reaches, and to locate the reaches (see Checklist for Establishing a New Reach, following this section).

- Round up a team of volunteers, if possible. Recruit your friends and neighbors!

- Write an informal proposal showing the results of the above efforts. This doesn't have to be formal or fancy, but it should include:

1) The name of your stream;
2) List of interested team members (name, address, phone, email);

3) A brief explanation of why you want to monitor the stream/site(s), and how monitoring might help larger goals;
4) Contact information for any professionals with whom you've consulted (name, agency, address, e-mail and phone number);
5) Copies of USGS or other maps with the rough location of your desired stream and/or sites identified.

CRITERIA FOR SELECTING REACHES TO MONITOR

Clark County volunteers generally monitor medium-to small-sized wadeable streams, most of which arise in the foothills of the Cascade mountains and move through the lowland basin to the Columbia River. We choose streams draining small sub-watersheds that represent different land uses including forest, rural agriculture, and developed areas. This arrangement allows some comparisons between stream characteristics at different elevations and levels of human impact.

The exact location of a monitoring reach will depend on characteristics specific to each creek (including access, owner permission, creek history, etc.) Resources that can help you identify the most effective and accessible places to establish new reaches include USGS quad maps, driving/walking tours (but don't trespass), your personal knowledge of the area, and the suggestions of local experts.

Criteria for selecting reaches to monitor on a given creek include:
1) Reasonable and safe access by volunteers.
2) Publicly owned land or permission of landowner to access and mark sites.
3) Giving a representative view of the stream as a whole and typical for its location in the watershed.
4) At least 150' upstream or 650' downstream of bank alterations such as bridges, riprap, etc., if possible. (Unless your purpose is to measure the effects of these bank alterations!)
5) Containing both pools and riffles, <u>if possible</u>.
6) Located at least one half mile apart on the same stream, if possible.

Once you have an idea of where you'd like to monitor, it is helpful to ask for feedback and/or recommendations from local natural resource specialists (Clark County, local municipalities, Clark Public Utilities, Washington Dept. of Fish and Wildlife, Washington Department of Ecology, US Forest Service, Department of Natural Resources, etc).
(see next section)

CHECKLIST FOR ESTABLISHING A NEW REACH

<u>Before You Go into the Field</u>

- Identify prospective monitoring reaches:
  1. Using the resources and criteria described above, select prospective monitoring reaches and mark them on a USGS quad map.
  2. Use the quad map in conjunction with the County Assessor's maps to identify the parcel number and look up the owner's name in the Assessor's office. This information can also be accessed via the "Maps Online" link on the Clark County webpage (www.clark.wa.gov).
  3. Confirm accessibility of the site through a visit or a drive-by. If private property, contact the owner regarding access. County staff can supply you with a permission form for establishing a monitoring site and a standard letter asking for permission.

4. Write a brief text (1-2 paragraphs) describing the reach, its location, how to access it, and why you've chosen it. If you consulted with anyone, be sure to list his or her name, title and contact information. Also, if you want to do something other than monitor the regular suite of parameters (e.g. you think you should monitor only chemical water quality, or only riparian vegetation, etc.), list the parameters you want to monitor and (briefly) why you think it's a good idea to diverge from the standard suite.

- Confirm selection of monitoring reach(es) with County staff.
- Document the reach:
  1. Locate the reach(es) on USGS quad maps.
  2. Determine stream miles to the nearest tenth of a mile, elevation to the nearest hundred feet, and the Washington State stream number for each reach; you'll need a USGS quad map, a map wheel, and the state Water Resources Inventory Area (WRIA) catalog, all available from county staff.
  3. Write a location description for each reach, including details of how to get there, ownership(s), and access requirements (e.g. advance phone call).
  4. Have staff create a data folder, binder, and hanging file for stream information; assign a site code number to each reach; and make photocopies of USGS maps with the reach(es) clearly marked.

<u>In the Field</u>

- Establish the reach baseline (see Reach Map protocol).
- Establish cross-section monuments, following our "Establishing Cross-Section Monuments" protocol.
- Locate the zero-point of your baseline as precisely as you can in geographic coordinates, either by visually estimating on a 1:3000 orthophoto provided by county staff or by taking readings with a GPS unit (accuracy 5 meters). If you do take a GPS unit, also take an elevation reading of where your cross-section line crosses the mid –channel point (see "Establishing Cross Section Monuments" protocol).
- Make a Reach Map, following our Reach Map protocol.

<u>After Your Field Day</u>

- **On your reach map** include the following information, which staff will help you to determine:
  1. The name of your reach, which in general is the name of the stream plus the stream-miles to the nearest tenth (but see staff regarding exceptions). Staff will help you to determine the number of stream-miles using USGS quad maps and a map wheel. Put the reach name at the top of your map in big capital letters.
  2. The elevation of your reach to the nearest hundred feet, or more precisely, if you can. You will use a USGS quad map if you didn't determine elevation in the field with a GPS unit.

- **On your location description narrative** add the following information:
  1. The reach name (generally, stream name plus stream-miles—see above).
  2. The elevation of the reach to the nearest 100 feet, or more precisely, if you can.
  3. How to find the zero-point of the baseline.
  4. Whether the baseline runs upstream or downstream.
  5. The total length of the baseline.

6. The true azimuth of the baseline.
7. If the baseline doglegs, the point(s) at which it doglegs and the true azimuth(s) that the baseline follows after doglegging. (See Reach Map protocol for more information on baseline length and orientation).
8. The width of the monitoring reach (i.e., lengths of the transects).

FIELD PROCEDURE: REACH MAP

EQUIPMENT NEEDED:

- pencils with erasers
- graph paper
- ruler
- protractor
- clipboard
- marker with permanent ink
- 3 tape measures, 100-200', marked in tenths of a foot
- sighting compass
- flagging tape
- stakes
- big nails
- rebar
- rebar caps (required on rebar)
- small sledge hammer
- hardhat and safety glasses (to use with sledge hammer)
- first aid kit

This procedure will guide you in drawing a stream reach map, which will help you document the location and path of the stream channel, various features of the channel and riparian area (area on either side of the stream), and important sampling information. The reach map will help you to replicate sampling procedures and track changes in the stream and riparian area. It is also an essential component in continuity of knowledge about your monitoring reach; as you compose this map, keep in mind that all those things you have up in your head won't do us any good if you don't write it down!

A volunteer monitoring reach is typically a 100 x 100 foot square area roughly straddling the stream (with exceptions that we will deal with later.) The central spine of this 100' square reach is a 100'-long baseline extending along the stream. You will make a reach map when first establishing your reach and then every 3-5 years thereafter, or as needed (for instance, if there is a major change in the reach). Once you have created a map, the original will be filed in your stream's binder in the Water Resources office, and you will be given a duplicate on which to document any changes that have occurred, each time you visit your reach.

Scale: Ideally, use a scale that will fit your entire reach on one sheet of 8.5 x 11 inch graph paper, leaving a ½" margin on all sides. One inch to twelve or fifteen feet usually works well. Draw out a scale bar on the map with increment distances marked, so that the scale can still be measured if the map changes size in duplication. For an example of this scale bar as well as other map features, see the sample map that follows.

NOTE: In the instructions that follow, measurements follow the "lay of the land." So if you're measuring up a hill, you extend the tape going up the hill rather than on a level. Therefore, if your reach is hilly, your reach map will not truly reflect the plan (overhead) view of the reach. At this stage, full-blown surveying is a luxury we can't afford!

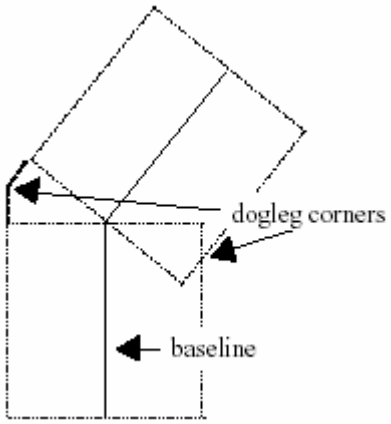
OPTION: LARGER REACH DIMENSIONS

The instructions below are written as if all reaches are 100' by 100', but you may wish to make your reach longer or wider than 100'. For instance, a broad stream may require a 150' wide reach to even minimally reflect its riparian area, and a reach that is 200' long might do a better job of reflecting the habitat diversity along the stream. Any reach size is okay as long as it is mapped accurately. Feel free to consult on this issue with Water resources staff or local biologists. Obviously, larger reaches take longer to map and survey; consider the extra time required when making a decision.

1. Decide where your reach will be; see "Identify Prospective Monitoring Reaches" in the Reach Establishment protocol.

2. Next, decide where your baseline will run. Typically, this will be a 100' straight line that stays close to the stream. If possible, locate both ends or at least the beginning-point at or near some fairly stable and prominent landscape feature, such as a big tree, stump, or signpost.
3. The beginning-point ("zero-point") of the baseline should be the end easiest for other people to find, following only your map and written instructions. This may be either the upstream or downstream end. If both ends are easy to find, choose the end easiest to access. If safe and permitted to do so, place a flagged stake, nail, rebar (which must be capped), or else just flagging, at the zero-point. Mark the flagging, "zero point." In areas that receive foot traffic, keep in mind that:
   a) Stakes are liable to get pulled out.
   b) Stakes and rebar might present a safety hazard.
   c) Markers can mar the beauty of a natural area. Weigh these factors as best you can.
4. Run a measuring tape from the zero-point in the direction you want your baseline to go. Try to keep it close to the stream. It is okay to cross the stream one or more times. If there is a fairly straight trail or road that parallels the stream, you can use it to set up your baseline. This will make mapping easier.
5. If the stream bends such that no straight line can stay within 20 feet of it, make a dogleg in the baseline. Mark that point with a flag and/or stake if appropriate. Then dogleg the tape until you reach the 100-foot point.
6. Draw your baseline on your map as a vertical line, using the scale you have predetermined. Standing at your zero-point, take a bearing to the endpoint or dogleg (see "Compass Use" directions following this protocol), and record the true azimuth ("true azimuth" = the compass bearing corrected to true north, on a 0-360° scale) to the nearest degree on your map alongside your baseline. (If your baseline doglegs, you will have to record more than one azimuth and use the compass to draw the dogleg at the proper angle on your graph paper. You may need to produce a cleaned-up version at home, using a protractor. To make scaling easier, it may be easier to tape a second piece of graph paper onto the first at the appropriate angle.) Clearly mark on your map the zero-point, the number of feet along the baseline at which doglegs occur (to the nearest tenth of a foot), the 100' point, and true azimuths of all lines.
7. Reference the zero-point of your baseline to two prominent nearby landmarks. Draw and describe the landmarks on your map, and record both the distance and true azimuth from the landmark to the zero-point. If the zero-point is at one of the landmarks (much preferred!), simply indicate what the landmark is on your map. For example, you may want to draw and write "stake for zero-point at edge of 6-foot diameter cedar stump, at 20°□true from center of stump."
8. From the zero-point, extend another 100' measuring tape perpendicular to your baseline. Use the compass to orient this tape correctly. (Simply add 90°□to your baseline's azimuth.) Such a line, perpendicular to the baseline, is called a transect. Normally, you will put the middle of the 100' transect at the baseline, so that the baseline bisects the 100' x 100' outline of your reach. However, feel free to offset the placement of the baseline within the square if that would make the reach more evenly straddle both sides of the stream. For example, if your baseline runs about 20' to the right of the stream, you could have the transects cross the baseline at the 70' rather than the 50' mark. If possible, monument or flag the two ends of this transect, which constitute two of the corners of the reach. Mark the flagging as appropriate.

9. Along this transect, measure the distance from the baseline to each wetted edge of the stream (the points where the water surface hits the banks). Record these distances on your map, and mark an "X" on the map at the locations where the transect crosses a wetted edge.
10. Sketch as much information as you can about the stream and riparian areas in the vicinity of this transect. Include observations about such features as vegetation types and locations, pools and riffles, gravel bars, downed logs, and human alterations. Indicate whether these features are measured to scale for location and size.
11. Now move the transect-tape up the baseline at 10- or 20-foot intervals, keeping its intersection with the baseline perpendicular and at the same number of feet that it was for the zero-foot transect. If appropriate, use stakes or flagged vegetation to mark the location of the transect lines along the baseline, and mark the flagging as "10' transect," etc. If these markers are not visible from the creek, place additional markers on the bank along the transect line—these markers will prove helpful in subsequent monitoring sessions. Mark distances and wetted edges on your map as above, and draw in any landmarks or prominent vegetation that occur near the ends of your transect lines.
12. If your reach doglegs, your reach shape will not be a nice square. Instead, it will have two or more rectangles that overlap each other. On one side, there will be a wedge-shaped piece of gap between the rectangles. If possible, close this gap by extending the outside lines of the two rectangles until they intersect, and make this a single outside corner (see diagram). On the other side, there will be a wedge-shaped overlap between the two rectangles. Eliminate this overlap by establishing a single inside corner where the two outside lines intersect (see diagram). Monument or flag any inside or outside corners if possible—it will enable you to much more easily determine the boundaries of your reach while in the field. And make very clear on your map exactly what the outside lines of your reach are.
13. When you have done the above for all transects, draw the stream by connecting the wetted-edge "Xs" with curvy lines. Draw the boundaries of the reach by connecting the corners with straight dotted lines.
14. You'll probably want to use the rough map you drew in the field to draw a more precise map at home, with straight lines, proper angles, legible handwriting, etc. For this, you'll need more graph paper, a protractor, and a ruler, preferably with a strip of the graph paper



pasted to it so you can measure distance-increments easily.

BE SURE THAT YOU HAVE THE FOLLOWING ITEMS ON YOUR MAPS:

- Stream name
- Date you surveyed for the map
- First initials and last names of all map authors
- Exact outside boundaries of the reach, drawn in straight dotted lines
- Baseline clearly drawn and marked as such
- Zero-point of baseline marked and labeled
- References to zero-point from two landmarks; these references consist of both a distance and a true azimuth from the landmark to the zero-point. The landmarks should be drawn in and described.
- True azimuth of baseline, written alongside

the baseline as "__?true."
- If the baseline doglegs, the distance(s) along the baseline at which the dogleg(s) occur, plus the true azimuths of the doglegged lines. The angles between the doglegged lines must be accurate on your reach map; use a protractor or compass to get the angles right.
- Wetted edges of the stream drawn in as curvy lines.
- Arrow marked "Flow."
- A legend, consisting of:
  - A scale, ticked off like a ruler with map dimensions. Do not put in text such as "One inch equals 20 feet," because dimensions may change when pages get photocopied!
  - A true north arrow, clearly marked.

AFTER COMPLETING THE "REACH ESTABLISHMENT" PROCEDURE (previous section in this manual), ALSO INCLUDE ON YOUR MAP:

- The number of stream-miles to the zero-point of your reach, to the nearest tenth.
- The elevation to the nearest 100', or more precisely if you can.

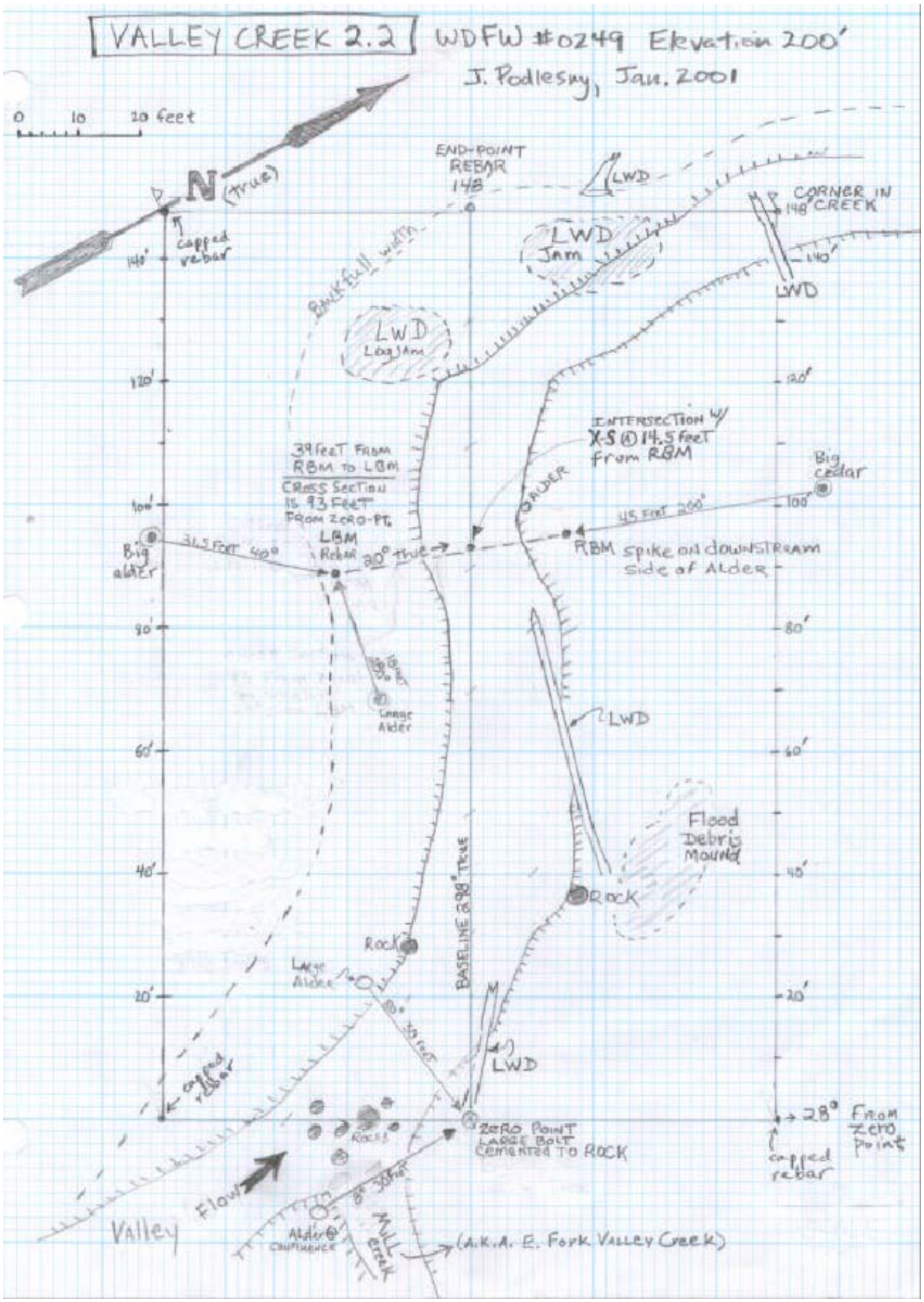
AFTER INSTALLING CROSS-SECTION MONUMENTS AT YOUR REACH (see "Establishing Cross-Section Monuments"), **ALSO INCLUDE ON YOUR MAP:**

- The cross-section monuments, indicated as "lbm" or "rbm" (left- and right-bank monuments—see protocol on establishing monuments), and as "rebar" or "nail in tree."
- References to each monument from one or preferably two landmarks—same procedure as for landmarking the zero-point, see above.
- The cross-section line as a dotted line, with the true azimuth clearly indicated.
- AS POSSIBLE, ALSO DRAW IN FEATURES OF THE STREAM AND RIPARIAN AREAS IN YOUR REACH: VEGETATION TYPES AND LOCATIONS, POOLS AND RIFFLES, GRAVEL BARS, DOWNED LOGS, HUMAN ALTERATIONS, ETC.

SAMPLE REACH MAP

(The original will be filed in your stream's binder in the office, and you will receive a copy on waterproof paper to take into the field with you.)

(see next page)


VALLEY CREEK 2.2
WDFW #0249 Elevation 200'
J. Podlesny, Jan. 2001
0 10 20 feet
N (True)
END-POINT REBAR 148
LWD
CORNER IN CREEK 148
LWD Jam
LWD Log Jam
LWD
capped rebar
140'
120'
100'
80'
60'
40'
20'
39 FEET FROM RBM TO LBM
CROSS SECTION IS 93 FEET FROM ZERO-PT.
LBM Rebar
30° True
INTERSECTION W/ X-S @ 14.5 FEET from RBM
ALDER
Big cedar
45 FEET 200°
RBM spike on downstream side of Alder
Big alder
31.5 FEET 40°
Large Alder
LWD
Flood Debris Mound
ROCK
Rock
Large Alder
BASELINE @ 98° TRUE
LWD
28° From Zero Point
ZERO POINT LARGE BOLT CEMENTED TO ROCK
capped rebar
Rocks
Valley Flow
Alder @ Confluence
Mill creek
(A.K.A. E. Fork Valley Creek)

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FIELD PROCEDURE: *COMPASS USE*

Clark County volunteers use the compass for two separate operations: 1) either working "from terrain to map" (taking a compass bearing from a given line in the field) or 2) working "from map to terrain" (following a bearing given on a stream reach map). The first operation is used when surveying the stream reach map, and the latter would be used to reestablish your reach lines during future monitoring visits, or to find stream reach monuments after a reach has been established, if thick growth or flooding alters the terrain.

THE COMPASS

The compass supplied with the field kit has been set to account for the region's 20-21° degree east declination, the difference between the magnetic pole and true north, so all of our readings will reference to true north. Remember to keep the compass level and away from iron and steel objects like belt buckles, rings, rebar, or clipboards when taking a bearing. The compass can be used for "quick accuracy readings" and "high accuracy readings", as explained below.

DEFINITIONS

A few definitions are useful for an understanding of compass use:

Bearing: The direction from one place to another, measured in degrees of angle with respect to an accepted reference line. This reference is the line to true north.

'Taking a bearing': To measure the direction from one point to another, either on a map or in the field.

'Following a bearing': To set a certain bearing on the compass and then to follow that bearing along a line in the field.

'Boxing the needle': To align the red end of the magnetic compass needle inside the orienting arrow of the compass housing.

Triangulation: Taking a bearing to a monument from two different locations.

USING THE COMPASS

From terrain to map – How to take a compass bearing from the terrain for your stream map by measuring the direction from one point to another on the terrain:

Quick Accuracy Readings: Generally, the first part of the stream reach map that requires a compass bearing is the baseline measurement. Stand at your "zero point" with your tape stretched along your baseline (see Reach Map protocol, Step 3), and open the compass cover all the way. Hold the compass about waist-level with the lid away from you. Aim the sight/sighting line on the compass cover down the baseline and "box the needle" by rotating the compass case so the orienting arrow aligns with the red magnetic needle (See diagram below). Read and record the bearing at the index notch. This method gives you a "quick accuracy reading".

High Accuracy Reading: If a higher accuracy is required, open the compass cover to about a 50-degree angle so that you can see the compass dial in the mirror when held to the eye. Hold the compass at eye level, peer through the sight, and align it along the tape measure on the ground. Observe the magnetic needle and the orienting arrow in the mirror as you rotate the housing to align the needle and the arrow ("box the needle"). The mirror angle will have to be adjusted in order to see both the compass dial and the measuring tape (or a landmark) through the sight at the same time. Read the bearing at the index pointer.

From map to terrain – How to follow a bearing written on your stream reach map to establish a point or line in the field, by setting the bearing on your compass. This method is used to reestablish the baseline or transects in the field, or to find the "zero point" of a baseline or the location of a landmark or monument already set up and measured by volunteers and noted on the reach map. This method is the reverse of the procedures described in "From Terrain to Map".

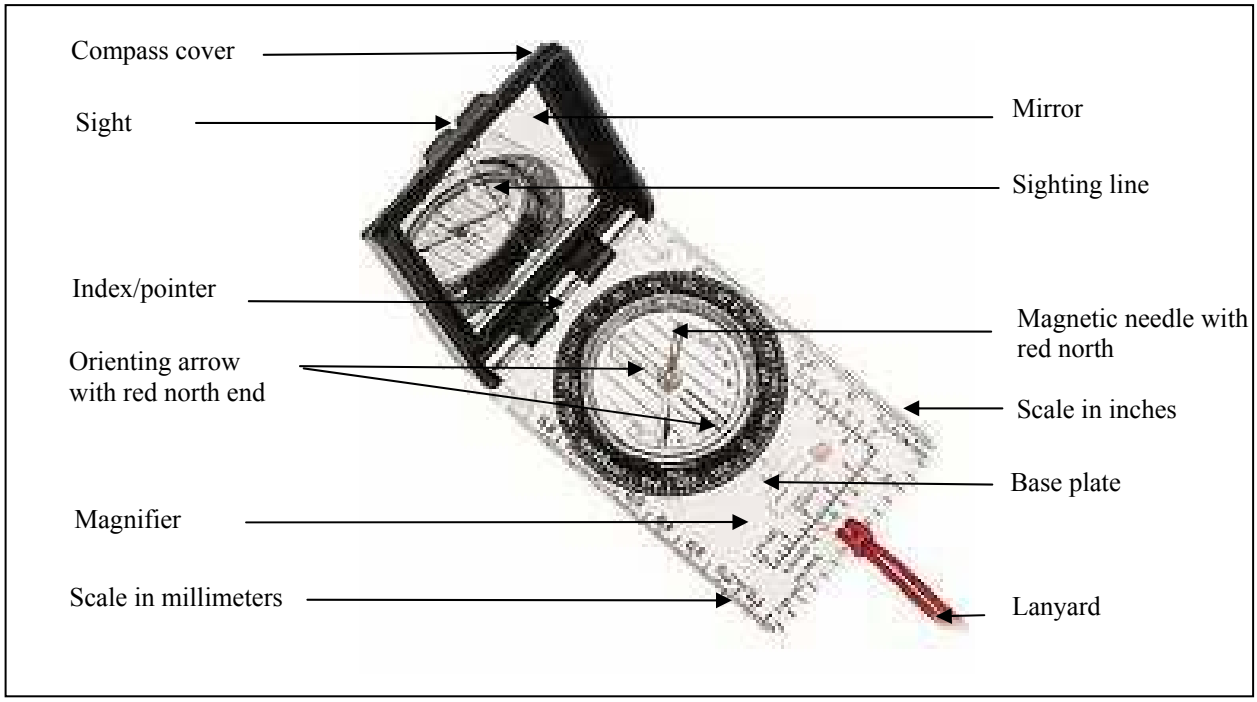
Quick Accuracy Reading: Use this method, for example, to find a monument that the brush has grown up around and hidden. Suppose, for example, that you cannot find a rebar monument you put in the year before. Your map notes that the monument is "20 feet at 270 degrees from the corner fence post". Simply stand at the fence post and turn the compass dial to set 270 degrees at the index/pointer. Hold the compass flat at waist level, and box the needle by ROTATING YOUR ENTIRE BODY until the red needle aligns with the orienting arrow. The sighting line will be pointing toward the monument, and you should be able to locate it in the brush.

High Accuracy Reading: Let's suppose you still cannot find your monument and will have to install a new one. You will need to be very accurate in order to get the monument in the same exact place. To do this:

- Use the sight to find your bearings (see "High Accuracy" section in "From Terrain to Map").
- Use triangulation to get as accurate a location as you possibly can. This involves locating your spot from two different reference points. Your reach map should have two different reference points for each important monument (see Reach Map protocol), and if you mark the spots indicated by both of these reference points, they should agree with each other. If they do not, you will have to use your best judgment as to where to locate the replacement monument. IF YOU HAVE TO RE-INSTALL A MONUMENT, BE SURE TO NOTE WHICH MONUMENT AND EXACTLY HOW YOU DECIDED WHERE TO PLACE IT.

Reference:

Burns, Bob and Mike Burns. *Wilderness Navigation*. Seattle: The Mountaineers. 1999.


Compass cover
Sight
Mirror
Sighting line
Index/pointer
Magnetic needle with red north
Orienting arrow with red north end
Scale in inches
Base plate
Magnifier
Scale in millimeters
Lanyard

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FIELD PROCEDURE: FISH AND WILDLIFE SIGNS

EQUIPMENT NEEDED:

- the five senses
- field guides if you have them and are inclined to use them, binoculars, hand lens
- data sheet, clipboard, pencil

Anytime you visit your reach, you will note any signs of fish or wildlife. You'll be most likely to observe animal signs when you first arrive at your site, but be open to observations that may occur at any time. How detailed and technical you wish to get is up to you, but even such information as "about six little brown birds," "a few fish fry about 2" long," or "tracks – raccoon?" can be useful to biologists. The UW Nature Mapping project will accept observations identified to species level only, so if you do know the specific or Latin name for the creature you observe, be sure to list it.

Note: Only write what you know – if you're taking a guess, indicate that it's a guess and why you've guessed it.

FISH

Your best bet is to quietly walk up to a pool, preferably not casting a shadow on it. If you're lucky, you may see some fish-like shapes holding still or darting around. Other possible sightings include spawners in riffles or pool tailouts, carcasses, or redds (salmon and trout nests), which are elongated oval mounds in the streambed that are algae-free, often with a depression on the upstream side.

If you can i.d. a fish by sight, please make a note of it. "Salmonid spp." would cover any salmon or trout that you might find. If you investigate your watershed and consult your local fisheries biologist or County staff, you will be able to make a pretty good guess as to what species of fish you might find in the stream at a given time of the year.

WILDLIFE

The visual observation approach recommended below can yield valuable information on the presence and absence of wildlife and their relative abundance in different survey areas. For identification, there are many publications and keys available to help you. The animal-tracks key in your field kit will help since most wildlife do not appreciate human observers and hide from view. Or you may wish to bring a knowledgeable partner (such as an Audubon member) to help you.

Birds

Birds may be the easiest creatures to spot. Look and listen for them as you walk into your reach. Take into consideration that different species inhabit different layers of the vegetation, from the dense, shrubby undergrowth to the top of the canopy.

Note the locations where you see and hear birds both spatially and vertically. Record the species that you are able to identify by sight or sound. Also document any evidence you see that birds are present, such as nests, egg shells, feathers, or tracks.

Herps

Herps (reptiles and amphibians) are more

secretive than birds. The best places to look for them are under rocks and logs, in damp spots, especially along the stream's wetted edges. Take care not to create too much disturbance on the fragile stream banks, and make sure you return all logs and rocks to their original positions.

In the spring, look for amphibian egg masses in slow-moving backwater areas, side channels, and other wetlands associated with the stream and in your reach area. If you can, take a trip to your stream reach on a spring evening to listen for breeding frogs.

Mammals

Mammals may be the most challenging to spot, but they often leave behind evidence of their presence. Note any signs of mammals that you see in addition to actual sightings. Signs may be in the form of nibbled plant matter, scat, bones, fur, tracks, trails, nests, burrows or dens. You can use the scat and tracks keys here and in your field kit to help identify these signs. We also have a more detailed animal tracks guidebook in the Streamkeepers office that you can consult.

Dogs

Note any sign of dogs in or near the creek, and take photos of them if you can. Dogs can eat spawning salmon and should not be left loose to do so. If notified, the Dept. of Fish & Wildlife can investigate and contact the appropriate landowner.

RECORDING WHAT YOU FIND

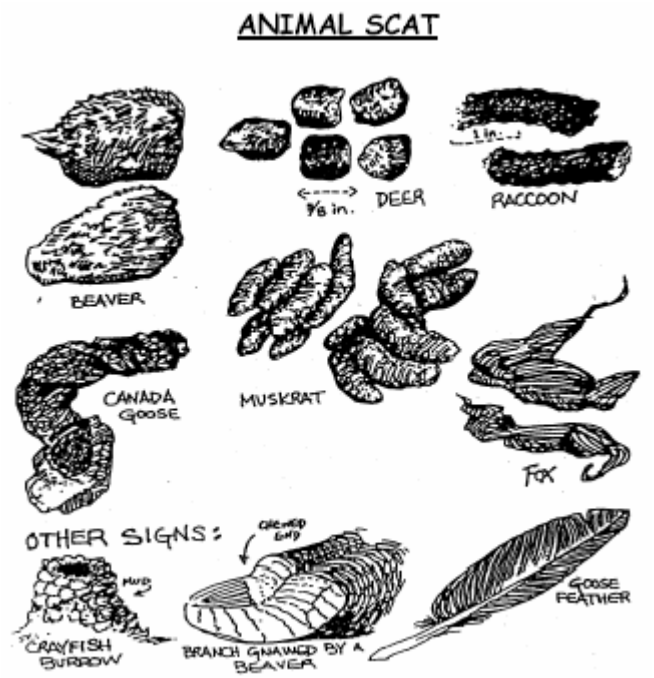
Record what you see in the space provided on your data sheet:

1. You can document the species you see, or use broad categories to record your wildlife sightings. For example, birds are categorized into types such as gulls, ducks, sandpipers, passerines (perching birds), raptors, etc. Herps can easily be distinguished as frogs, salamanders, snakes, turtles, etc.

2. Include information on number, size, and activity. Feel free to estimate, using the "~" symbol in front of a number to denote "approximately."

3. If no fish or wildlife are observed, write "None" in the data boxes.

4. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data. If more than one person worked on these data, put the initials of the person with the most experience or knowledge.


ANIMAL SCAT
1 in.
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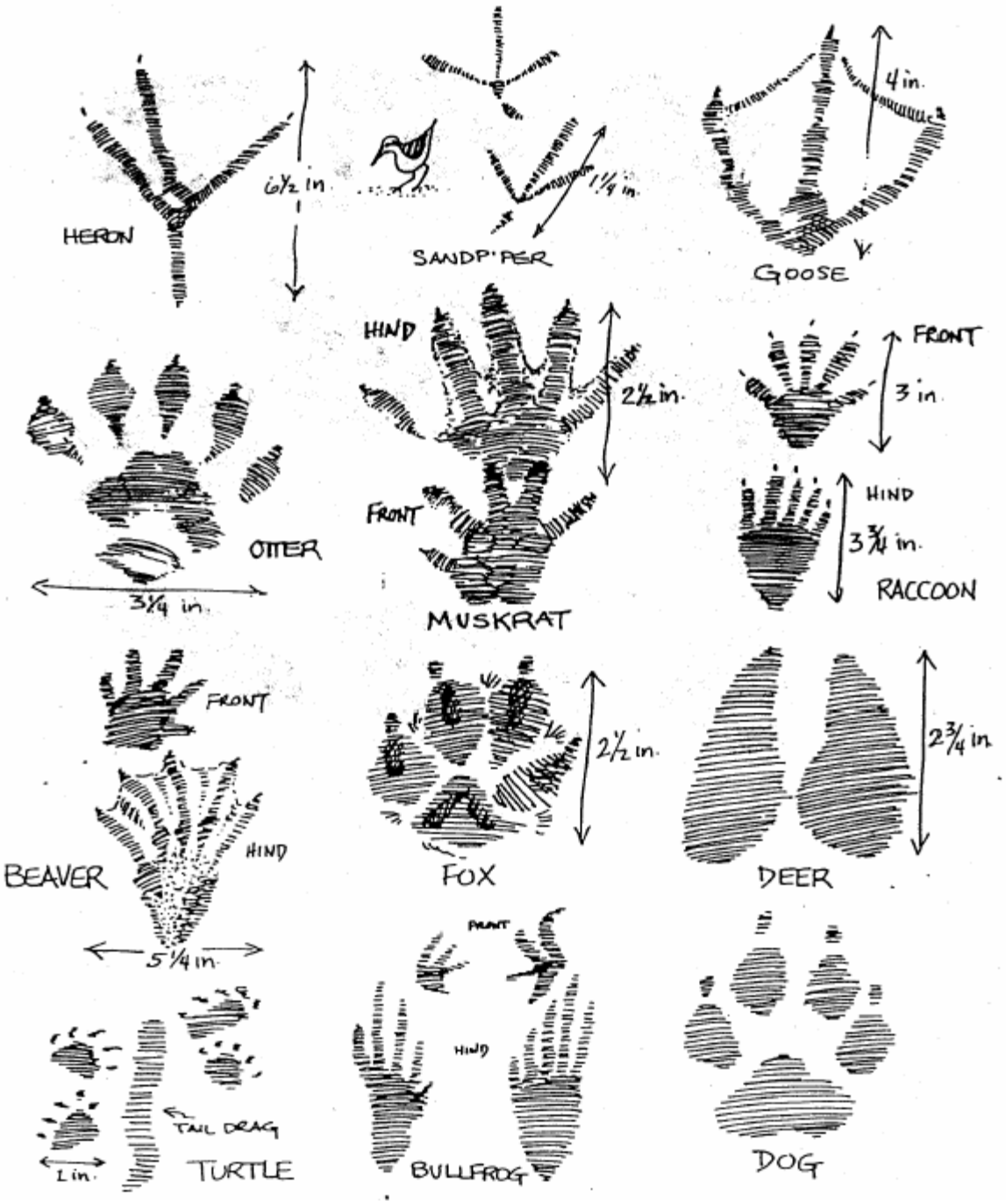
DEER
RACCOON
BEAVER
CANADA GOOSE
MUSKRAT
FOX
OTHER SIGNS:
CHEWED END
MUD
CRAYFISH BURROW
BRANCH GNAWED BY A BEAVER
GOOSE FEATHER

FOOTPRINTS (TRACKS)



FIELD PROCEDURE: FLOW

Note: This procedure primarily follows the discharge measurement procedure described in the 1994 Timber Fish & Wildlife (TFW) Ambient Monitoring Program (Schuett-Hames et al. 1994), with some modifications suggested by the Washington State Department of Ecology. The 1999 TFW protocol calls for more cells and longer velocity averages, but County technical advisors consider the 1994 TFW protocols to have adequate accuracy for our program purposes. Furthermore, this protocol has been modified for Clark County's volunteer program to include the appropriate equipment.

EQUIPMENT NEEDED:

- Marsh McBirney Model 201D current meter
- Top-setting rod for the current meter
- 100' flexible measuring tape marked in tenths of a foot
- 2 stakes
- pocket calculator
- watch to note time of day
- small shovel
- extra D-cell batteries
- data sheet, clipboard, pencil

In this procedure, you will take measurements that enable calculation of the amount of water that the stream is moving ("discharging"), recorded in cubic feet per second ("cfs"). The actual discharge calculation will take place back at the office. This procedure is best performed by two people: one taking measurements and the other recording.

When to measure: Generally, you'll measure flow each time you monitor each reach. If possible, wait until a day or two after major storms, to give the stream time to return to its baseflow. Also keep safety in mind—think twice about going into water above your knees.

Where to measure: Measure flow at any point in your reach, at a place where most of the channel cross-section is >2" deep, and the water is moving well, but not turbulent. A suitable site should not have side-channels, undercut banks, or flow obstructions such as large rocks, logs, or aquatic vegetation. If a few large rocks are in the way, you can move them temporarily about six feet downstream while you perform your measurements. If there are eddy currents at the edges, you can make temporary 'dikes' using large rocks. Lay them out from the bank in peninsular fashion in order to concentrate the flow. If there is no suitable site within your reach, you may walk outside your reach IF no water leaves or enters the stream in between.

PREPARING THE METER AND STAFF:

1. While still on dry land, remove the velocity meter staff from its case (see picture below). Move the moveable rod up slightly. (You may need to loosen or tighten the knob on the slide fitting at the top.) From the "gear box" take out the orange current meter bag containing the unit and sensor.
2. Take the sensor out of the bag. Inspect the three sensor "eyes" to be sure they are clear of debris or film (see figure 1). Check if the meter is functioning by turning the scale knob to CAL and the time constant knob to 2. Within 10 seconds the digital display should read between 9.8 and 10.2. (See "Meter Troubleshooting" below for instructions on opening the battery compartment.) Record the meter calibration number on the data sheet.
3. Attach the sensor to the top-setting rod. The sensor mount slides over the grooved shank on the top-setting rod and is secured by tightening the thumb-screw.
4. Unfurl about as much cable from the orange back as you think will be necessary to measure flow, typically about 3 feet. Keep the rest of the cable wound in the orange bag

to avoid hang-ups on obstacles or stream debris.

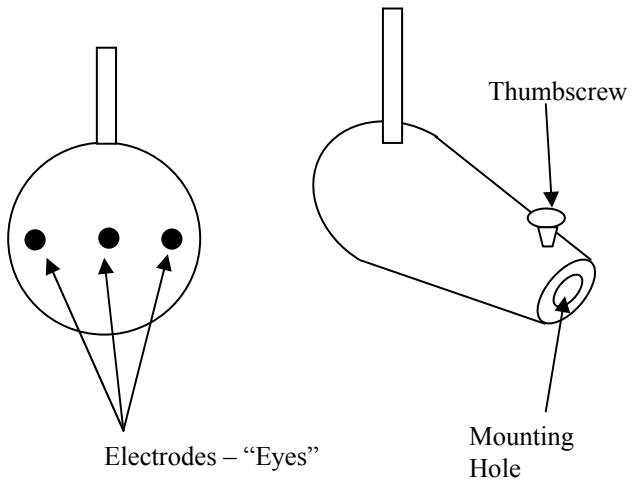


Figure 1. Current meter sensor.

MEASURING FLOW:

1. Record the time on your data sheet.
2. At the point where you have decided to measure flow, stretch a tape across and above the wetted portion of the stream channel perpendicular to the direction of flow. Secure the taped ends by wrapping around vegetation, large rocks, or stakes. (If you are performing the cross-section survey on the same day, you may be able to perform the flow measurement along the cross-section tape line.) On your data sheet, note the distance on the tape corresponding to the water's edge on each side of the stream, to the nearest tenth of a foot.
3. To measure the total discharge, you will measure depth and velocity at 15-20 measured points. Back at the office, we will calculate discharge by creating "velocity cells" from your readings. Before taking measurements, you will have to predetermine an average interval that will yield 15-20 measuring points across the width of the wetted channel. The data sheet guides you to do this by dividing the stream width by 20, then rounding up as necessary. *(For example, if the wetted channel is 13' wide, 13/20 = 0.65. If you round up to 0.7, you will have about 13/0.7 or 18 cells.)*
4. ***Zero readings at first wetted edge:*** Reconfirm the tape reading at the edge of dry land. If the bank is undercut (which you should have tried to avoid!), you'll have to estimate how far back the water goes. (You can do this by putting a stick into the undercut and then measuring this distance on the stick.) Record the tape distance, the depth (should be zero), and the velocity (should also be zero).
5. ***Proper stance:*** Put the velocity meter's strap around your neck and enter the stream downstream of the tape. When taking measurements, stand with the wading rod at arm's length and your feet upstream and downstream of each other, off to the side of where the water flows past the rod. You will be facing upstream at about a 45° angle. Hold the rod so the sensor faces into the flow.
6. ***First reading next to the edge:*** Adjust the sensor so that it just clears the bottom. Your first point of placement should be as close to the wetted edge as you can get the sensor eyes in the water. At this point you don't need to worry about the depth at which you set the sensor.
   a) Record the tape reading on your data sheet, to the nearest tenth of a foot.
   b) The tell-tail (piece of colored tape attached to the back of the sensor fitting) should point downstream. If the tell-tail is not pointing straight back from the sensor, turn the rod so that the sensor is facing directly into the current and the tell-tail is pointing straight back from it. Estimate the angle that the staff is pointing away from directly upstream, to the nearest 10°, and record that angle in the "angle" column on your data sheet. If no rotation was required, record nothing in this column.

c) Measure depth at this point using the increments on the rod. Note that the intervals are in tenths of a foot, and half-foot and foot marks are double and triple lines, respectively. Record the water depth from the staff, to the nearest hundredth of a foot. (You will have to estimate between the 0.1' markings on the staff.)

d) Turn the scale meter switch to "Ft/Sec" and the time constant switch to "2". The velocity reading will be updated every 10 seconds at this constant. Record the velocity reading when stable. If the reading is erratic, then increase the time constant to 6 using the switch. The velocity reading will be updated every 30 seconds at this constant. Record the velocity reading when stable. Repeat the process with a constant of 20 if stable readings again cannot be acquired, although the display will only be updated every 100 seconds at this constant so be patient.

7. ***Low-velocity conditions:***

a) If the water isn't moving fast enough to get a reading, write "insf/v" on the data sheet.

b) If the readings are erratic at the 20 time constant setting, measure the velocity again. If the difference is <20%, keep the first reading. If the difference is >20%, take a third reading, and record the average of all three.

8. ***Intervals for subsequent measurements:*** You will generally move across the stream at the average interval distance you calculated above, except that:

a) Smaller intervals should be used wherever noticeable breaks in velocity and depth occur, or where the current is very deep and fast.

b) Intervals can be doubled if you are measuring in a place where the channel looks very uniform and you find velocities within 10% of each other at three consecutive points *(for example, readings of 0.45, 0.47, and 0.49 ft/sec).* However, if you find that velocities begin to change, you should revert to the original interval distance.

9. ***Readings between first and last:***

a) Set the rod on the stream bottom and record the tape reading on your data sheet, to the nearest tenth of a foot.

b) The staff should be vertical, which you can determine by briefly letting go of it. Read the stream depth from the large scale on the rod, and record it to the nearest hundredth of a foot (estimate between tenth marks). In fast current, water will "pile up" on the rod at the water's surface. Record the depth of the water at the base of the pile.

c) ***If the water depth is less than 2.5 feet***, velocity measurements should be taken with the sensor placed at 6/10 the distance from the water surface to the stream bottom. You can do this easily by aligning the number on the moveable rod that corresponds to the depth in feet, to the number on the handle that corresponds to the depth in tenths of feet. *For an example depth of 1.9 feet, align the ONE on the moveable rod to the NINE on the handle.*

d) ***For depths greater than 2.5 feet***, you should seriously consider whether it's safe for you to be in the stream! If you're sure it is (you'll need chest waders), you will need to take two velocity and angle measurements, at 2/10 & 8/10 of total depth. To do this:

i) Put slashes across the velocity and angle boxes, to make room for the two readings you will take.

ii) For the 2/10-of-depth reading, take the depth you measured and multiply it

by 2, then set the depth on the top-setting rod using this number. For an example depth of 2.9, multiply by two (5.8) and set the FIVE on the moveable rod to EIGHT on the handle. Record velocity and angle at this point, as described above.

iii) For the 8/10-of-depth reading, divide the measured depth by 2, then set the depth on the top-setting rod using this number. For an example depth of 2.9, divide by two (1.95 rounded to 1.9) and set the ONE on the moveable rod to NINE on the handle. Record the velocity and angle at this point, as described above. Record the velocity and angle at this point, as described above number. For an example depth of 2.9, divide by two (1.95 rounded to 1.9) and set the ONE on the moveable rod to NINE on the handle. Record the velocity and angle at this point, as described above.

10. ***Wide variations in velocities:*** If any velocity reading is an order of magnitude different than the previous one, the recorder should ask the sampler to confirm that reading.

11. ***Measuring a divided stream:*** If the only suitable site to measure is one where the stream is divided by an island, treat it on the data sheet as if the two (or more) inside wetted edges are at the same distance along the tape. This will make it possible for the computer to calculate your flow properly. Draw a little picture to explain what you are doing on your data sheet. See following page for an example:

12. ***Last reading next to the edge:*** Follow steps for "First Reading Next to the Edge," above.

13. ***Zero readings at far wetted edge:*** Follow the same procedure as for "Zero Readings at First Wetted Edge," above.

14. In the "Sampler's Initials" box to the right of the data boxes, put <u>all</u> the initials of <u>one</u> sampler taking responsibility for the data, which will generally be the person with the most experience or knowledge.

15. Turn the meter off when finished taking readings, and see storage and transport instructions below.

Meter storage and transport:

- **NEVER** transport the staff with the sensor attached. Take off the sensor, and place it in the orange bag between sites.
- At the end of each monitoring day, always be sure to remove the sensor assembly, and store staff, meter, sensor in their proper places. If possible, dry these parts with the rags in your field kit before storing.

Meter troubleshooting:

- If the meter falls in the water, open the battery compartment on the back as soon as possible by twisting the set screws loose by hand. Dry the battery terminals and cable connections, and let the compartment air dry as much as possible before replacing the cover.
- If the meter fails the calibration test, replace the batteries and try again. The calibration can only be corrected at the factory.

<u>MONITORING EXTREME FLOWS:</u> It is very useful to know about extreme high and low flows in a stream. Therefore, if:

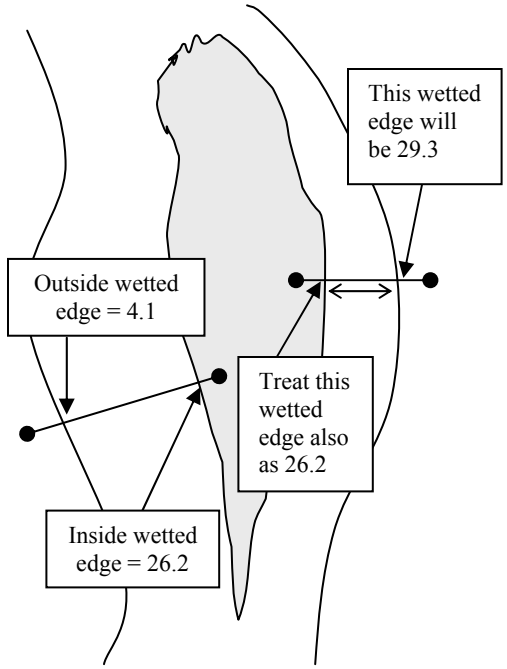
- your stream is experiencing an extreme flow,
- a field kit is available,
- it is **SAFE** to monitor, and
- you have a team of at least two, then, you are welcome to borrow a field kit and a data sheet.

<u>STREAM GAGES:</u> Your stream may have a water-level gage installed on it, or we may be able to install one if you're willing to do the leg-work. Over the course of time, dual readings from both

the flow meter and gage would yield a formula that would enable us to estimate discharge simply by reading the gage. (We also have to calibrate the gage by periodically making dual readings and measuring the channel cross section.)

Gages enable more frequent measurement of discharge, thereby making possible more thorough interpretations of the stream flow in a watershed. For instance, gage information can help to determine the probability of a flood or low-flow event of a certain degree, or to show how quickly flow responds to a storm event. These are valuable tools for watershed planning and restoration.

Please see County staff if you think a gage is or can be installed near one of your reaches.



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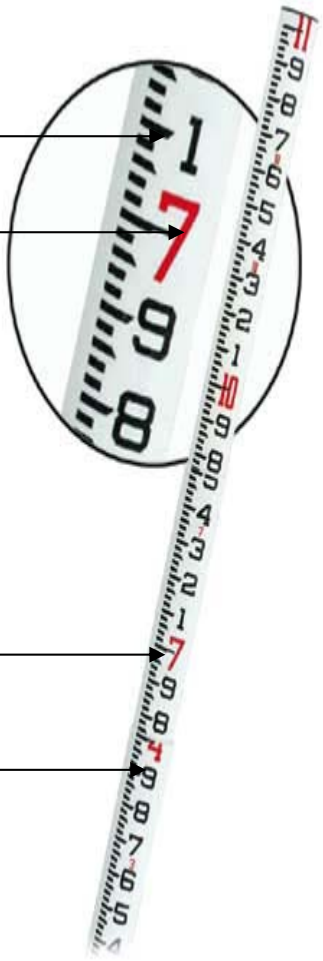
FIELD PROCEDURE: GRADIENT



STADIA ROD

EQUIPMENT NEEDED:

- Sight Mark 2 sight level ("peashooter"—in leather case)
- 100' tape
- stadia rod
- waterproof marker
- data sheet, clipboard, pencil

Using this procedure, known as the "peashooter" method, you will measure the downhill slope (gradient) of the water surface. Two people are required: a sighter and a rod-holder. The sighter should ideally be someone with a steady hand and a good eye. A tip: the sight level fogs up in rainy weather, so carry it in your shirt pocket (close to your body) to minimize fogging.

1. The rod-holder extends the stadia rod from the bottom section until the button clicks. The rod should now read above 7'. The sighter gets into sighting posture and looks into the distance through the level, leveling it by getting the bubble in the middle of the 3 lines. The rod-holder puts the stadia rod straight up on level ground next to the end of the sight-level and determines the sighter's pupil-level height, to the nearest tenth of a foot. (The stadia rod markings are unusual: feet are written in red and tenths in black; the halfway point between tenths is the pointed tip of the longer line in between. See picture on this page.) Enter this "pupilheight" on the data sheet.
2. The sighter takes the sight-level, the marker, and the tape reel, while the rod-holder takes the rod, the clipboard and pencil, and the end of the tape. The two walk at least 25, but hopefully 50-100 feet apart on a straight stretch of the stream, ideally including two identical habitat units (e.g., the top or bottom of a pool or riffle), where the line of sight is good. (**NOTE:** Placement will be different if you are measuring gradient for a stream gage— consult with staff if this is the case.) You may have to do some minor pruning of overhanging branches or walk outside of your reach to get a good sight-line. Run the tape between you and record the distance on the data sheet, to the nearest tenth of a foot.
3. The sighter stands at water level--on a rock, gravel bar, or bank, so that his/her toes just clear the water. If there is no place to stand at water level, stand in the water, mark the water level on your boot, and measure and add that distance to the sight-level reading that you will take in Step 5.

4. The rod-holder holds the stadia rod so that the bottom of the rod is at water-level. Set it on a rock or your boot toe to make sure it is at the surface of the water. Make sure it is straight up by suspending it momentarily from the tip.
5. The sighter, standing at water level anywhere in the creek with the same posture as in step 1, sights through the sight level (with the label at the top) toward the stadia rod, and adjusts it so that the bubble is centered on the sight level's center mark. The sighter then determines where the center mark crosses the stadia rod, either by reading the numbers on the rod her/himself, or by giving signals or verbal directions to the rod-holder to hold the top of a finger where the center line on the level crosses the rod. Record that "sight height" on the data sheet. (If the sighter was standing in the water, add the water depth to that height.)
6. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data. If more than one person worked on this data, put the initials of the person with the most experience or knowledge.
7. The computer in the office will calculate the gradient, which is simply the "rise over run," i.e., the difference between pupil-height and sight height, divided by the horizontal distance between the sighter and the rod. (see diagram on this page)

FIELD PROCEDURE: ESTABLISHING CROSS-SECTION MONUMENTS

EQUIPMENT NEEDED:

- reach map from prior monitoring
- 100' measuring tape
- 100' of string
- 6" – 8" galvanized nails
- small sledge hammer
- hand pruner
- lengths of ½" rebar 2 – 4 feet long
- rebar caps
- hardhat
- safety glasses
- first aid kit
- flagging tape
- line level
- compass
- stadia rod
- clipboard, pencil

In this procedure, you will establish a permanent monument on each bank of the stream from which to measure its cross-sectional profile. You will perform this procedure only once: before your first August monitoring session. (If the monuments are removed or disturbed, you will have to reestablish them.) By stretching a string and a measuring tape between the two monuments (using the Cross-Section Survey field procedure), teams can take annual measurements that will accurately show changes from year to year. Large changes indicate possible problems in the watershed.

CHOOSING A LOCATION FOR THE LINE

In most reaches, you will establish a single cross-section line, preferably across a fairly straight and even stretch of stream in a riffle, run, or glide (not in a pool or cascade). Midway between bends is ideal. (If your reach has two pool/riffle sequences, you may want to establish two cross-section lines, one in each of the riffles.) Do not put the line across a place where the streambed or banks are bedrock (i.e., you want an "alluvial" rather than a "confined" reach). In exceptional circumstances, you might have to place the line outside of your reach – but it should be near enough to mark on your reach map.

Consider the following points when establishing your line:

- You'll want a place easy to find again and to put in monuments.

- When possible, find two trees >8" diameter that are on opposite sides of the stream and show no sign of imminently falling. In that case, you can establish monuments simply by driving nails in low on the trunks of the two trees. Where trees are not available, you will have to drive rebar into the ground, leaving 4" obtruding from ground level. Often one monument will be in a tree and the opposite will be located with rebar.

- Attachment points should be a few inches to a couple of feet above the level of bankfull flow. (The level of bankfull flow is the top of the lower stream bank, over which water at flood stage would be flowing over onto a flood plain.) Try to make points well up the bank. HOWEVER, the line should be low enough that the stadia rod (14.5 feet as of July 1999) can measure up to it from the lowest point in the channel, and you can accurately read it.

- The cross-section line should be as perpendicular to the channel as possible.

- The two monuments need to be easily accessible without damaging the banks. (Otherwise, changes in the channel's

cross-section will be due to the stream teams themselves!)

- Avoid placing rebar in high-traffic areas, for both safety and the integrity of the markers.

- If you place your cross-section line in a good place to measure stream flow, you will then be able to combine measurements for both protocols. However, in that case your line must be perpendicular to the stream channel.

LOCATING THE MONUMENTS

Monuments should ideally be directly across the stream from each other, marking a line that is more-or-less perpendicular to the channel. To determine perpendicularity, first choose a point on either bank where you wish to place your first monument. Stand in the middle of the channel facing this chosen point. Hold your arms out to your sides and shift your feet until your arms line up with the flow. Then bring your hands flat together in front of you. Your hands should be pointing at the chosen marker. If they are not, move your body up- or downstream until they are. Now double check your position by again holding your hands out from your sides and bringing them together in front of you. You will be pointing to the marker along a line that is roughly perpendicular to the flow. Then turn 180 degrees keeping your body in the same place, and repeat the movement with your arms. You will be pointing along the same perpendicular line towards the other bank at the best spot for your second monument. Use this procedure to determine if two trees will work or if you'll have to place rebar on one or both banks.

INSTALLING THE MARKERS

1. To decide exactly where to drive nails or rebar, have two people stretch a string between the proposed points, with the line level attached in the middle. BE CAREFUL NOT TO FLIP THE LINE LEVEL OFF THE STRING. Adjust as necessary to make the line level and perpendicular to the channel.

    - There must be NO interference with the string. Use the hand pruner to remove branches that are in the way.

    - If the monument will be a nail in a tree, try to locate the nail on the upstream or downstream side of the tree so that the nail itself is parallel to the channel; however, the most important concern is to make the line perpendicular to the channel. Locate the nail as low in the tree as is practical.

    - If the monument will be rebar driven into the ground, hold the string about 2 inches above ground level. The person on the other bank should adjust height as necessary.

    - If there are no trees, put both pieces of rebar at the height of the lower bank.

2. Before driving nails, make a number of pleats in flagging tape, leaving a 6" tail on the end. Then push the nail through the pleats. (This will assure that some flagging will remain if the tail is pulled off.)

3. If driving rebar, use hardhat and safety glasses. Use the two-foot lengths of rebar if possible. If the ground looks hard, use a piece that has a point ground into it. If the ground is soft, use a longer piece. You can also pound fist-sized rocks

into the ground around the rebar to stabilize it.

4. Leave 3" of nail or 4" of rebar protruding.

    - If the nail is not parallel to the channel, bend it with hammer blows near the base until it is. But do not bend the nail head closer than 1" to the tree trunk.

    - If you cannot drive the rebar any further and it is secure, you can cut it off at 4" height with the hacksaw. If you cannot drive the rebar any further and it is not secure, you will need to find another spot or get a larger sledge hammer.

5. If the monument is rebar, install an orange safety cap on top. Then use the hacksaw to score the rebar just below the bottom of the cap. This will be the attachment point for the string.

MARKING THE MONUMENTS

Make it as easy as you can for volunteers to find the markers in future years. You may wish to:

- Tie flagging around the trunk of the tree at eye-level

- Tie flagging in the brush above your rebar

- Tie flagging to overhanging vegetation at eye-level in mid-channel near the cross-section line

However, if the site is frequented by the public, flagging may serve as both a visual nuisance and an invitation to disturb the markers. Use your best judgment.

RECORDING THE MONUMENTS

Measure the distance from your reach's zero-point to the cross-section line, and record this information on your reach map. Also on your map, indicate the placement of the markers:

- For nails in trees, record the approximate position and height on the tree.

- For rebar, indicate the approximate position.

- Also give the distance and true bearings from two prominent landmarks nearby (one of which can be your monument on the other bank.) (See "Compass Use" section for instructions on taking bearings.) That way, if the tree or rebar "disappears" (whether through vandalism, blow-down, or a year's worth of brush growth), you can relocate or reestablish it.

SEE THE SAMPLE MAP AT THE END OF THE REACH MAP PROTOCOL.

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FIELD PROCEDURE: CROSS-SECTION SURVEY

EQUIPMENT NEEDED:

- string
- line level
- flexible measuring tape marked in tenths of a foot
- stadia rod
- compass
- hand pruner
- "Photos-Summer" protocol
- directions to the cross-section monuments (hand-drawn reach map, verbal directions, someone who knows)
- data sheet, clipboard, pencil

In this procedure, you will survey the stream channel cross-section with a series of measurements along a permanently-established line. The data you gather will be entered into a computer database that can generate a graph of the cross-section and calculate the degree of change in the cross-section "footprint" over time.

Survey the cross-section at the place in your reach where permanent monuments have been established. Generally there will be one set of two monuments in each reach. The location of these monuments should be indicated on your reach map. See "Field Procedure: Establishing Cross-Section Monuments" for further details.

It works best to have at least two people carry out this procedure: one taking readings, and the other recording.

1. Avoid trampling down the banks, or your own team will be the cause of changes in the cross-section!

2. Tie a string tightly between the attachment points on the two permanent monuments. For a nail in a tree, the attachment point is directly next to the head of the nail. For a Piece of rebar in the ground, the attachment point is the scored line in the rebar just below the orange rebar cap (or about 2" down from the top of the rebar if the cap is missing). When in doubt, use the line level to make sure your attachment points are at the same elevation. Tie the string in such a way that you can easily untie it without cutting it. It is crucial that the string not touch anything in between the monuments. If necessary, pull or prune away any brush that interferes. Hang a line level at mid-point on the string to confirm that the string is horizontal; take it off before proceeding.

3. Starting at the <u>left bank</u> (facing downstream), stretch a measuring tape marked in tenths of a foot across the stream between the two permanent monuments. Keep the tape away from the string by attaching it as closely as possible to the tree (if the monument is a nail) or the ground (if the monument is rebar). At the left-bank monument, use the piece of wire at the end of the tape to secure the end-piece such that the tape's zero point is on the nail. At the right-bank monument, wrap the tape around the monument several times and secure the reel to something on the ground. The tape should be fairly tight, but it will sag below the string, which can be stretched more tightly. Make sure that the tape does not touch the string at any point.

4. One person records on the data sheet while the other measures with the stadia rod. Begin at the zero-point – the left-bank monument. Read the height from the ground to the string, to the nearest <u>tenth of a foot</u> **(DO NOT GIVE MEASUREMENTS IN INCHES).** Be sure to have your eye on level with the string.

5. Assure that the rod is straight up by holding it loosely and finding the point at which it balances itself. In general, do not look at the ground as you place the stadia rod. This will prevent unconscious skewing of the measurements due to avoiding rocks, etc. Read from the side of the rod that is actually touching the ground (the up-bank side).

6. The person with the stadia rod moves along the cross-section line, measuring from the ground to the string. Two numbers are given at each point: the horizontal reading on the tape measure, and the vertical distance from the ground to the string –- both in tenths of a foot.

7. You do not have to measure at uniform horizontal intervals; in fact, you should not use uniform intervals. Instead, use longer intervals where the slope or terrain is regular, and shorter intervals where it is irregular (such as at the steep drop-off at the edge of the bank). In general, intervals should be 2" – 24" when measuring above bankfull (see definition below) and 2" – 18" when measuring below that line.

8. Be sure to take measurements at the following landmarks, and to write the following abbreviations in the far-left column of the data sheet:

   a) lbm, rbm = left-bank and right-bank monuments

   b) lbfull, rbfull = left or right bankfull point. This is the crest of the bank over which water would flow onto the floodplain at flood stage. Normally there will be such a point on at least one of the banks, but it is possible that there is no such point on one or either bank. If not, look for the height on the bank at which woody vegetation that is at least three years old begins. At the base of this vegetation, there should be old leaf litter forming into soil below. (This may be covered by sediment deposited by flood waters.) If the bankfull level is still unclear, you may have to look up and down along the channel to extrapolate where this line should be.

   c) lbwe, rbwe = left- and right-bank wetted edge. If the water level is fairly uniform across your line (which it should be if the monuments were well-placed), these two vertical measurements should be equal and should reflect the level of the water across the channel.

9. **Undercut bank:** To measure the wetted edge at an undercut bank, be sure to measure all the way to the wetted edge – don't just stop at the bank edge. (See diagram that follows.) To get the height to the wetted edge, measure the height to the water level just below the undercut edge, this will be at the same level as the wetted edge. Also take a horizontal distance reading to the edge of the undercut bank. Then use the stadia rod to measure the distance from the edge of the undercut bank to the wetted edge.

10. If you wish to provide a double-check on the water level, you can measure the water depth at mid-channel, or at more frequent points if the water-level is not uniform across the channel due to small pools or cascades. Enter water-depth measurements in the column labeled "wtr."

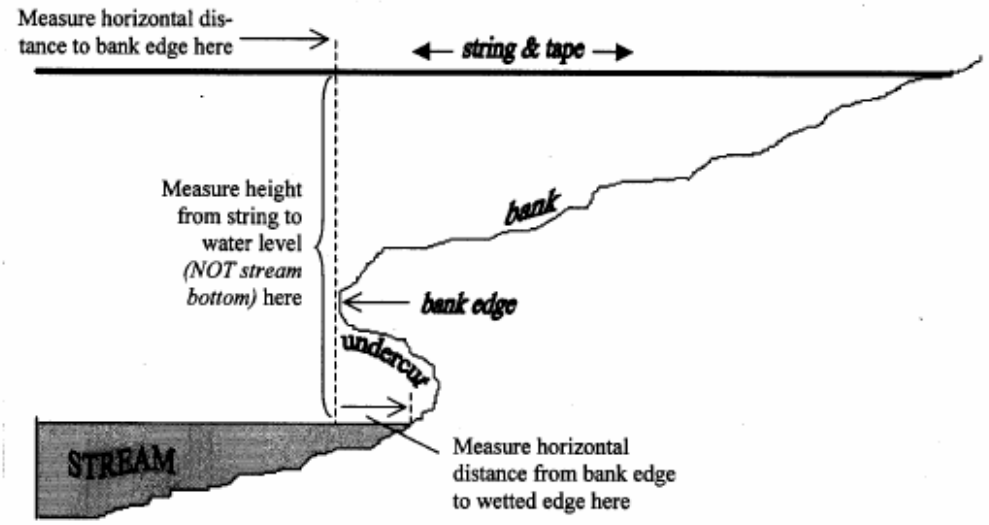
11. Proceed as described above all the way to the right-bank monument.

12. In the space provided on your data sheet, calculate the bankfull width, which you will need to perform the Erosion/Revetment and Pools monitoring protocols.

13. **Before taking the tape and string down,** perform the "Photos-Summer" protocol. You may also be able to perform the Flow protocol using this tape, if it is not too high for the flow meter's staff and is at a good point to measure flow (see "Where to Measure" in the Flow protocol).

See samples on following pages……

MEASURING THE WETTED EDGE AT AN UNDERCUT BANK:



SAMPLE CROSS-SECTION FIELD SHEET:

Cross Section Survey: **Sampler's initials:** JLTB

Abbreviations:

lbm, rbm left & right-bank monuments
d horizontal distance from lbm (in tenths of a foot)
ht stadia rod reading from ground to string (in tenths of a foot)
wtr height of water from streambed (in tenths of a foot)
lbfull,rbfull left/right bankfull level; top of bank over which water would flood
lbwe,rbwe left/right bank wetted edge

Descr	d	ht	wtr	(cont.->)	Descr	d	ht	wtr
lbm	0	1.05				21.3	4.9	0.3
	2.0	1.1				22.0	4.9	0.3
	4.0	1.4				23.1	5.0	0.3
lbfull	4.8	1.5				24.0	5.0	0.3
	6.3	1.9			rbwe	24.6	4.8	0
	6.8	2.5				24.8	3.5	
	7.4	2.9				25.2	3.0	
	7.7	4.0			rbfull	26.6	2.4	
	9.6	4.1				28.6	2.3	
	11.0	4.1				30.5	1.9	
	12.5	4.1				32.0	1.7	
	14.0	4.2				33.3	1.4	
	15.5	4.2				34.3	1.2	
	17.0	4.4				35.3	1.0	
lbwe	18.7	4.6	0		rbm	36.4	0.8	
	19.9	4.9	0.2					

Bankfull width = (d @ rbfull) - (d @ lbfull) = 21.8' *(Needed for Erosion/Revetment & Pools protocols)*

5'
26.6
- 4.8
21.8

(For a sample of how this data can be turned into a graph for interpretation, see next page.)

SPREADSHEET FOR CROSS SECTION SURVEY

	input		output	
	measured		assumed	
description	d (ft)	ht (ft)	d (ft)	elev
lbm (nail)	0.0	1.1	0.0	-1.1
	2.0	1.2	2.0	-1.2
	4.0	1.4	4.0	-1.4
lbfull	4.8	1.5	4.8	-1.5
	6.3	1.9	6.3	-1.9
	6.8	2.5	6.8	-2.5
	7.4	2.9	7.4	-2.9
	7.7	4.0	7.7	-4.0
	9.6	4.1	9.6	-4.1
	11.0	4.1	11.0	-4.1
	12.5	4.1	12.5	-4.1
	14.0	4.2	14.0	-4.2
	15.5	4.2	15.5	-4.2
	17.0	4.4	17.0	-4.4
lbwe	18.7	4.6	18.7	-4.6
	19.9	4.9	19.9	-4.9
	21.3	4.9	21.3	-4.9
	22.0	4.9	22.0	-4.9
	23.1	5.0	23.1	-5.0
	24.0	5	24.0	-5.0
rbwe	24.6	4.8	24.6	-4.8
	24.8	3.5	24.8	-3.5
	25.2	3.0	25.2	-3.0
rbfull	26.6	2.4	26.6	-2.4
	28.6	2.3	28.6	-2.3
	30.5	1.9	30.5	-1.9
	32.0	1.7	32.0	-1.7
	33.3	1.4	33.3	-1.4
	34.3	1.2	34.3	-1.2
	35.3	1.0	35.3	-1.0
rbm (nail)	36.4	0.8	36.4	-0.8

Stream name: Peabody **Reach #:** 2 **Date:** 7/23/99

Names: J. Baccus, E. Chadd

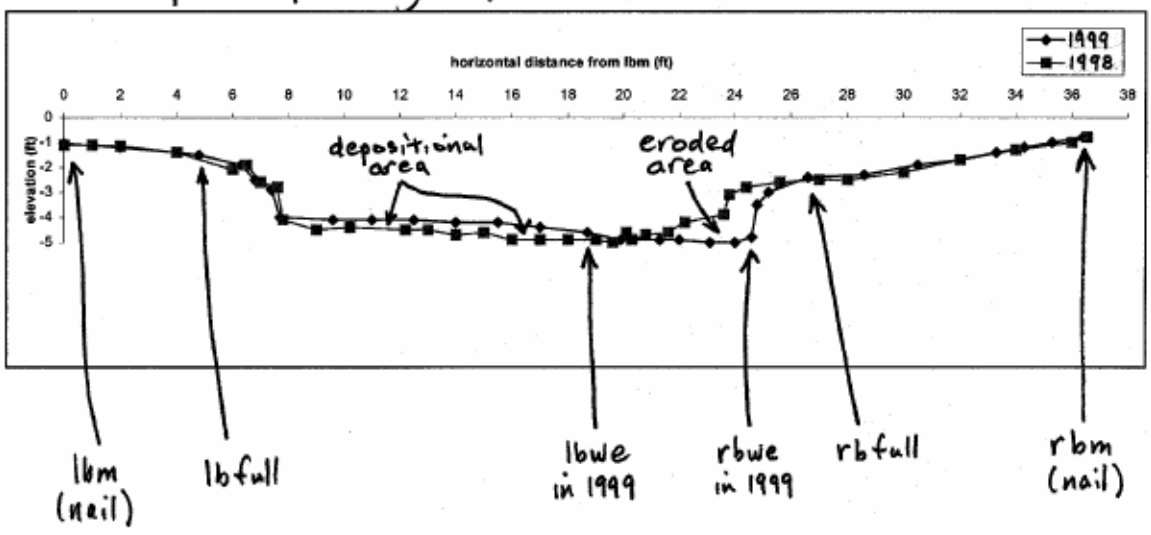
Location of cross section: 20' from zero point, between two large alders

Large flood events in past year? Major floods this past winter.

Abbreviations:

lb, rb = left bank, right bank (looking downstream)
m = monument (attachment point on the nail/rebar to which the string and tape are attached)
lbm, rbm = left & right bank monument
d = horizontal distance from lbm (in tenths of a foot)
ht = stadia rod reading (height from ground to string)
elev = assumed elevation ***(assume that elevation of lbm = 0')***
lbfull or **rbfull** = bankfull level: top of bank, over which water would overflow onto floodplain
lbwe, rbwe = left/right bank wetted edge

Superimposed graphs from 1999 and 1998:



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FIELD PROCEDURE: PHOTOS – SUMMER & WINTER

EQUIPMENT NEEDED: SUMMER

- Cross Section tape and string still stretched across the stream
- 2nd 100-ft tape, to stretch along baseline
- disposable camera
- photo log in field notebook
- flagging tape
- large Woody Debris and Erosion/Revetment protocols
- datasheet, clipboard, pencil

EQUIPMENT NEEDED: WINTER

- disposable camera
- photo log in field notebook
- knowledge of the position of the cross-section transect for your reach, from your reach map, or written/verbal description
- datasheet, clipboard, pencil

Photos provide a visual record of channel and riparian features which are archived at the county office. Summer photos show the channel at leaf-out and in low-flow condition. Winter photos, taken after leaf-fall, show some channel features that summer photos do not.

SUMMER PHOTOS:

1. Begin with the cross-section tape and string still attached from the Cross-Section Survey protocol.
2. Stretch your second 100 foot tape along your baseline. Refer to your hand-drawn reach map or description of the zero-point location and compass bearing, if necessary.
3. Try to have a person or other familiar object in the photo as a size reference – but be sure not to block whatever the photo is supposed to show! Also, if possible, try to include a landmark--a culvert, bridge, fence, big rock, or other structure--that may help locate the photo's location.
4. Photos should be taken of all the following (see sample photo log on the next page for examples of what to write):
   a) The cross section transect with three pieces of flagging tape hanging from the string, taken from downstream at mid-channel. On the photo log, indicate how many feet the photographer is standing downstream of the cross-section line.
   b) Views upstream and downstream from the cross-section line at mid-channel.
   c) Each piece of large woody debris (LWD) with a large enough field of view to see the surrounding channel and riparian area. On the photo log, indicate how many feet it is from your zero-transect to the LWD. Note: To know what constitutes a piece of LWD, you will have to pause and perform the Large Woody Debris protocol. You may take down the Cross-section tape and string at this point if you need the tape for measurements.
   d) Any erosion or revetment areas, if you have not already photographed them during your Streamwalk. Here you will need to pause and perform the Erosion/Revetment protocol. Fill out the photo log in a similar fashion to that for the LWD protocol.
   e) Any interesting or problem areas:
      - Wildlife signs; redds, tracks, beaver dams, etc.
      - Fish passage problems
      - Anything causing habitat problems
      - Capital improvements
      - On the photo log indicate how many feet upstream or downstream of the zero-point the photo's subject is.
   f) Also feel free to snap shots of volunteers at work or play that we might be able to use as mementos or promotional materials.

Be sure to write everyone's name on the log.

5. Fill out the photo log completely. See the sample below. Abbreviations that you can use are printed below and on the photo log.
6. Check "Yes" in the 'Photos taken' box on your data sheet, and write the initials of the person who completed the photo log. If you didn't take photos at this site, check "No" in this box.

CLARK COUNTY VOLUNTEER MONITORING - PHOTO LOG

Camera #:__4___ **Date**: _01/_15/_03_ Sampler's Initials: _REW_____

Site name or location description (repeat below as 'break' as necessary): Jenny Creek 010_____

Photo #	Subject	Vantage Point
5	X-Sec tape	20' d/s @ mid-ch
6	Facing u/s	x-sec line, mid-ch
7	Facing d/s	x-sec line, mid-ch
8	LWD @ 35' u/s of zero-pt.	LB
Break	Camera #5	New disposable camera
1	Erosion 85' u/s of zero pt.	RB
Break	Gee Creek050	New sample site
2	x-sec tape	30' d/s @ mid-ch

The scoop on your photo logs

A picture can be worth 1000 data points – that's why we include photos in our monitoring program. When you return your film, it's developed and the photos are scanned. Then we "process" the photos by lightening or darkening parts as needed, attaching information from your photo logs to the photos, organizing and storing the photos in a systematic way, and copying these files into the County's computer network. Eventually, our database will be able to instantly retrieve these photos.

But to get this all right, we need your help! Please note the following:

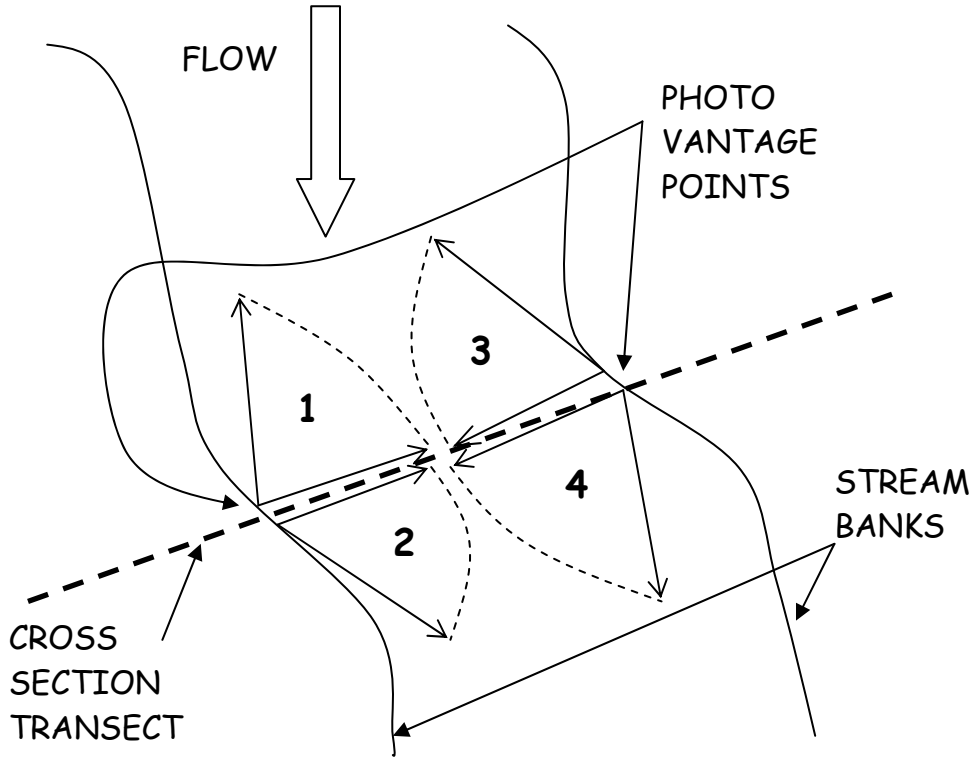
- All entries in the photo log need to clearly indicate who, what, when, and where.
- Whenever you change the date, site, sampler, or camera # you need to make a "breakout" line in the log that makes this change absolutely clear.

WINTER PHOTOS:

1. Try to have a person or other familiar object in the photo as a size reference – but be sure not to block whatever the photo is supposed to show! Also, if possible, try to include a landmark – a culvert, bridge, fence, big rock, or other structure – that may help locate the photo's location.
2. Take four photos from along the cross-section transect for your reach (see diagram on next page):
   - Stand along the cross-section transect on one bank. Take a photo facing across the creek angling upstream. Note: In all of these photos, aim the shot so that the cross-section transect is in the frame, but near the edge. Either get the opposite-bank monument in view, or imagine where it would be.
   - From the same position, take a photo facing across the creek angling downstream.
   - Now cross the creek if possible (in wintertime this may not always be possible to do safely!), stand along the cross-section transect on the opposite bank, and take a photo across to the other side and angling upstream.
   - From the same position, take a photo facing across the creek and angling downstream.
3. Take photos of anything else of interest, explaining the reason for the photo on your photo log. Some examples:
   - Wildlife signs: redds, tracks, beaver dams, etc.
   - Fish passage problems
   - Any potential habitat problems
   - Capital improvements
   - Volunteers at work or play

   If the subject of the photo is a natural feature, indicate how many feet it is upstream or downstream of the zero-point of the reach.
4. Check "yes" in the 'Photos taken' box on your data sheet, and write the initials of the person who completed the photo log. If you didn't take the photos at this site, check "No" in this box.

WINTER PHOTOS DIAGRAM



1-2-3-4 = PHOTO FIELDS

FIELD PROCEDURE: LARGE WOODY DEBRIS

EQUIPMENT NEEDED:

- 100' tape, stretched along your baseline
- retractable tape
- ruler
- camera, photo log
- "Photos-Summer" protocol
- data sheet, clipboard, pencil

In this procedure, you will tally, classify, and photograph large pieces of wood that intrude into the stream's channel along your stream reach.

Large woody debris (LWD) enters the stream from the adjacent riparian zone and plays a crucial role in shaping habitat for aquatic life. It:

- creates diverse pool/riffle habitat
- provides cover for fish
- traps sediment and smaller organic debris such as logs and twigs
- prevents spawning areas from being inundated with large sediment loads
- retains organic matter long enough for it to break down and become more appetizing to aquatic invertebrates

Definitions – we define 4 categories of LWD:

1. ***A* dead/dying log** is a piece of wood that:

    a) Is dead or will die within a year;

    b) Is no longer supported by its own roots;

    c) Is longer than 10 feet and has a diameter of at least 10 inches at the thickest point; AND

    d) Intrudes into the bankfull channel (see definition of bankfull in sidebar box).

WHAT'S BANKFULL, ANYWAY?

The **bankfull level** is the crest of the bank over which water would flow onto the floodplain at flood stage. Normally there will be such a point on at least one of the banks.

If there is no such point on either bank, look for the lowest point at which you find woody vegetation at least 3 years old with an accumulation of organic material beneath it – e.g., old leaves, grass, or soil. (This organic material may be covered by sediment deposited by last year's flood waters, so you may have to poke around a bit.)

Another method to determine the bankfull level is to find a place up- or downstream where the bankfull level is evident, and then extrapolate back to your spot.

LWD within the bankfull channel will affect the flow of water at flood stage, so another sign that the LWD is within the bankfull channel is that you'll see signs of erosion or deposition near the LWD.

2. ***A* living log** is a piece of wood that:

    a) will not die within a year (roots still in contact with soil), but is fallen or tipping;
    b) is longer than 10 feet and has a diameter of at least 10 inches at the thickest point; AND
    c) intrudes into the bankfull channel (see definition for 'bankfull' above).

3. **A rootwad** is a piece of wood that:

    a) does not qualify as a log;

    b) has a root system at least 3 feet in diameter;

    c) has a diameter of at least 10 inches at the base of the stem where it meets the roots;

    d) has roots that are detached from their original position; AND

    e) intrudes into the bankfull channel.

4. **A logjam** is an accumulation of 5 qualifying logs or rootwads that are in contact with one another or associated with the same structure, intruding into the bankfull channel by at least 4 inches. If you count a logjam, do not tally the individual logs/rootwads.

However, there are **exceptions** to the above guidelines. For example, a log or rootwad may be partially buried in the bank, so you may not be able to see its full size. If simple attempts to jostle it are unsuccessful, and if it appears to be functioning to trap sediment and debris, or to create pools or bars, then it qualifies as a log or rootwad even if the dimension criteria aren't apparent. As a local habitat guru once said: "If it's performing the functions of LWD, it probably is LWD!"

FIELD PROCEDURE:

1. For each LWD piece of any type, tally on your data sheet the number of pieces by category and zone of **lowest** intrusion. The zones are defined as:

    a) the **wetted channel** (the wet part of the stream!) on the day you are monitoring.

    b) the **bankfull channel** (see previous sidebar), if the LWD does not intrude into the water.

2. After tallying, write out and circle the total number in each box. Remember to write zeroes if none is observed. **Don't leave any box blank!**

3. Take photos of the LWD pieces, using the "Photos-Summer" protocol.

4. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data, even if you wrote zeroes in all the boxes. If more than one person worked on this data, put the initials of the person with the most experience or knowledge.

FIELD PROCEDURE: EROSION/REVETMENT SURVEY

EQUIPMENT NEEDED:

- 100' tape, stretched along your baseline
- bankfull width calculation from Cross-Section data sheet
- "Photos-Summer" protocol
- camera, photo log
- data sheet, clipboard, pencil

Erosion is the wearing-away of the land surface by water or wind. Here we refer specifically to the erosion of stream banks.

Revetment refers to any action taken by humans to make a streambank more resistant to erosion. A typical revetment consists of a blanket of large "riprap" rocks, but revetment may also consist of wooden or concrete bulkheads, log cribbing, cabled trees, revegetation, and a number of other technologies. Both erosion and revetment are signs of bank instability and can present a number of problems to fish (see inset below).

WHAT'S ALL THE FUSS ABOUT EROSION & REVETMENT?

The following information on erosion and revetment was taken largely from the *Streamkeeper's Field Guide* (Murdoch and Cheo, 1996):

A diverse mix of mature riparian vegetation growing on the banks of a stream indicates that the banks are relatively stable. An undercut bank, if well-vegetated, can still be stable and provide excellent protective habitat for fish. A certain amount of scouring or erosion generally occurs on the outside bend of stream meanders, where water velocity is greatest. In this survey, you are looking for signs of unstable banks, erosion beyond that caused by natural forces, and human intervention to stabilize the banks.

A stream bank with little or no vegetation usually indicates that excessive bank erosion is occurring. Signs of erosion include rills and gullies cut by runoff flowing down the banks into the stream channel. Sloughing or collapsing banks are another obvious sign of erosion. Unstable bank undercuts threaten fish habitat, as they are highly prone to sloughing.

Armoring banks with rock or concrete may remedy emergency erosion problems. However, artificial bank stabilization tends to deflect and concentrate the force of streamflow downstream to unprotected areas. Thus, forcing a stream into an unnatural human-preferred course may accelerate erosion downstream. It also limits the stream's ability to create a natural diversity of habitats. For this reason, you need to look for and note any signs of artificial bank stabilization.

FIELD PROCEDURE:

1. Walk your reach, looking carefully for places where the bank has either eroded or been revetted.

2. Only record eroded areas that reach bankfull height and are at least two bankfull-widths long. (See your cross-section data for your bankfull width.)

3. For eroded areas, indicate:

    a) the approximate length of the eroded area, in feet

    b) the highest height of the eroded area, in feet

    c) the probable cause of the erosion (check all that seem to apply):

        i. slope failure from above

        ii. bank undercutting by the stream channel, i.e., where the sides of the bank have been dug out by the force of the water and the bank collapsed above the undercut

        iii. channel scour, i.e., where the channel has dug the bed of the stream down lower and lower, until the bank has collapsed because its abutment is gone

        iv. new-fallen large woody debris

        v. human-made bank alteration upstream or on opposite bank

        vi. other (indicate)

4. For revetted areas, indicate:

    a) the approximate length of the revetment, in feet

    b) the type of revetment (check all that apply):

        i. continuous blanket – layer of rock, tires, etc. on the stream bank

        ii. bulkhead – retaining wall made of wood, steel, or concrete

        iii. spur dike – structure that juts out into the stream

        iv. check dam – low structure crossing the stream

        v. large woody debris placement – trees cabled or dug into the banks

        vi. bioengineering – vegetation planted to protect the bank

        vii. other – old car bodies, etc. Describe on the data sheet.

5. Take photos of eroded and revetted areas, following the "Photos-Summer" protocol.

6. **If there are no eroded or revetted areas, write "None" on the data sheet.**

7. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data, even if all you wrote was "None." If more than one person worked on this data, put the initials of the person with the most experience or knowledge.

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FIELD PROCEDURE: POOLS SURVEY

EQUIPMENT NEEDED:

- stadia rod
- bankfull width calculation from cross-section data sheet
- data sheet, clipboard, pencil

1. During your Cross-section Survey, you determined the bankfull width of your reach. This is simply the horizontal distance between the bankfull points on either bank; if a bankfull point was only determined on one bank, extrapolate to a point on the other bank that would be at the same elevation.

2. Find your bankfull width on the following chart to determine the minimum residual pool depth for your reach:

Bankfull Width	Minimum Residual Pool Depth
0-8.2 (ft.)	0.3' (ft.)
8.2-16.4'	0.7'
16.4-32.8'	0.8'
32.8-49.2'	1.0'
49.2-65.6'	1.2'
>65.6'	1.3'

3. Walk along your reach with the stadia rod, looking for possible pools. These will be areas with deeper water and slower current.

4. If you find a possible pool, determine whether it has the minimum residual pool depth that you determined above. Residual depth is the level of water that would be in the pool if the water level were so low that water wasn't running out of it anymore. To measure it, you need two measurements (see accompanying diagrams):

   a) The maximum depth, which won't necessarily be in the middle of the pool (estimate the maximum depth if the pool is too deep to fully access); and

   b) The pool's outlet depth, taken at deepest point of the crest or obstruction that forms the pool's downstream outlet. The downstream end of the pool is the point at which the calm water begins to accelerate. Look for a narrowing tongue or calm pool water that runs down the middle or side of the stream on the downstream end of the pool. The apex of that tongue should be the deepest part of the outlet.

The pool's **residual depth** is the difference between these two depths.

5. If the pool qualifies according to the above criteria, write its residual depth to the nearest tenth of a foot on your data sheet.

6. For each pool, record pool-forming factors. Keep in mind that pools form in two ways:

   - Obstructions can dam the stream and form a pool upstream of the dam.

   - Objects or channel features can direct the water flow in such a way that it scours out the stream bottom in a certain place. Such scour pools are formed and maintained during high-water events, when the stream has a great deal of energy to move sediment. If you visualize these high-water events, you'll often be able to surmise what created a scour pool.

On your data sheet, check off as many of these pool-forming factors as apply:

a) **Instream wood:** A piece of wood can dam the water upstream of it; and cause turbulence downstream that digs out a pool; or do both.

b) **Instream rocks or exposed bedrock:** Same as instream wood.

c) **Roots of standing trees or stumps:** Can cause the stream to dig out an area underneath or downstream.

d) **Outside of bend:** Greater hydraulic energy at the outsides of bends can dig pools out of the bank.

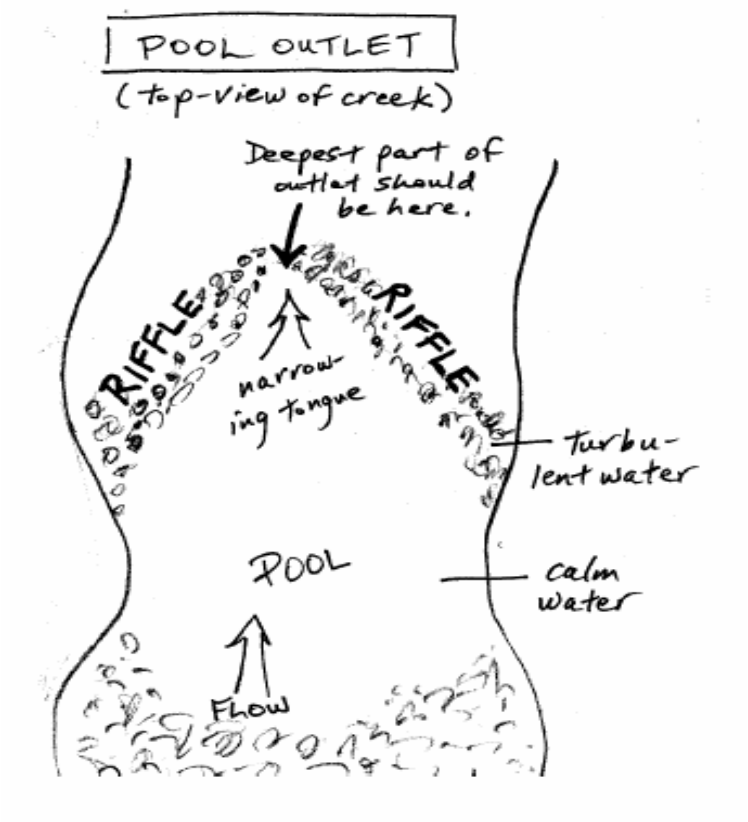
e) **Resistant banks upstream** (may be rock, clay or armored): Can "bounce" high-current energy downstream to dig out a pool elsewhere.

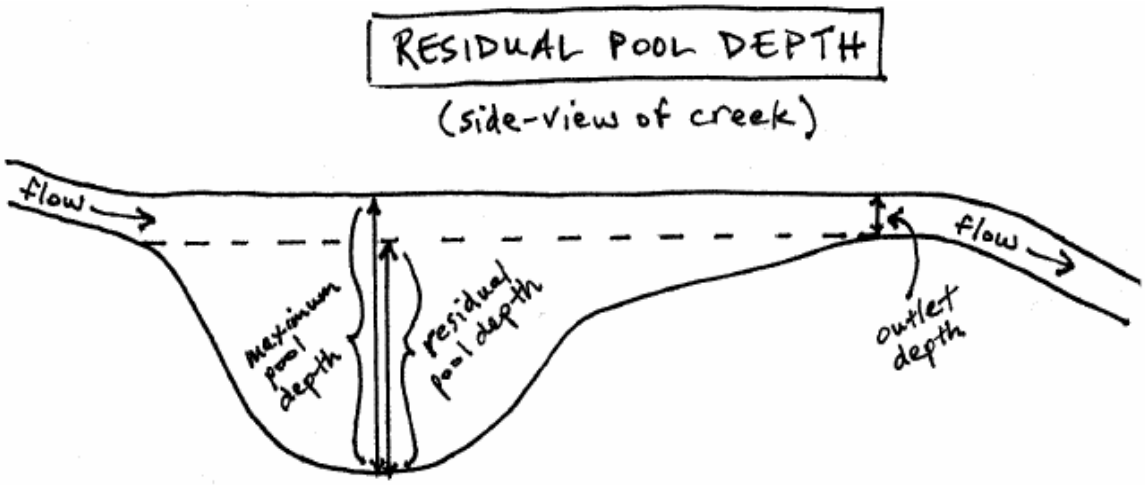
f) **Beaver dam:** Uncommon, but obvious when they occur.

g) **Other/Unknown:** Describe possible pool-forming factors if you can.

7. If there are no pools, write "None" on the data sheet.

8. In the "Sampler's Initials" box to the right of the data boxes, put <u>all</u> the initials of <u>one</u> sampler taking responsibility for the data, even if all you wrote was "None." If more than one person worked on this data, put the initials of the person with the most experience or knowledge.





residual pool depth = maximum depth − outlet depth
(from TFW diagram)

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FIELD PROCEDURE: PEBBLE COUNT

EQUIPMENT NEEDED:

- 2 rulers marked in mm and inches
- latex disposable gloves, to protect against sharp objects in the water
- waterproof marker for boot tips (optional)
- data sheet, clipboard, pencil

In this procedure, you will measure the particle size distribution of the surface sediment of your stream. These measurements can be used to calculate the sediment's size classes and median grain size ("D50"), which provide valuable information about both the habitat and hydrology of a stream.

It is best for two (or more) people to perform this procedure: one to pick and measure rocks exclusively; and the other to record, and pick and measure as possible.

1. Pick an area within your reach (or nearby if there is no appropriate area in your reach) to perform the pebble count. It will not necessarily be the same exact spot each year. The area should be a channel-spanning riffle or run[1], at a point where the bottom appears relatively homogeneous. If you see broken glass or other dangerous trash in this area, take precautions, remove the trash, or find another area.

2. You will walk back and forth across this area, heel-to-toe. Each time you take a step, you will put your index finger into the water until it touches the bottom. Assure that your finger enters the water randomly by either:
    a) closing your eyes as your forefinger goes below your waist, or
    b) making a notch or line on the tips of your boots, and always inserting your finger directly in front of this point.

3. Measure whatever you first touch with the inside corner of your index finger, be it silt, gravel, or a boulder. If you touch sand on top of a boulder, you measure the sand, not the boulder.

4. Don't count bedrock, garbage, construction debris, or organic materials. If you come to an area of the channel that is bedrock only, skip over that area and move to an area with sediment (see #1 above).

5. If the piece is obviously smaller than 4 mm, you can tally it right away. Otherwise, use the ruler marked in special increments.

6. Measure rock diameters not along their longest or shortest axis, but along the intermediate axis, which is perpendicular to the other two. To measure, find the longest axis; then find the smallest dimension that is perpendicular to the longest axis. There is now one more axis that is perpendicular to both the longest and shortest axes--that is the intermediate axis. See diagram below.

7. If you can't easily remove the rock from the bed, excavate around it and measure it in place. (The intermediate axis will be the smaller of the two exposed axes.) Tally these in the "Embedded" column on your data sheet.

8. For each piece of sediment measured, make two tallies on your data sheet:

    a) one in the appropriate row for the pieces size class, in either the "Loose" or "Embedded" column (not both!). The classes are: > 4,000 mm; >250-4,000 mm; >

[1] Riffle = shallow area where water flows swiftly over gravel and rock, creating surface turbulence;
Run = area with little surface turbulence but relatively high velocity

64-250 mm; > 16-64 mm; > 2-16 mm; > 0.06-2 mm; < 0.06 mm; 'wood'; and 'other'.

b) one in the "Total tally" row, to keep track of how many pieces you've counted. The recorder should verbally repeat each measurement back to the caller for error checking before placing the tally mark.

9. Repeat this procedure, walking heel-to-toe zigzagging back and forth across the riffle, until you have taken 100 measurements. (It will go fast once you get into the rhythm!) Don't walk back along the same line you've walked before!

10 In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data. If more than one person worked on this data, put the initials of the person with the most experience or knowledge

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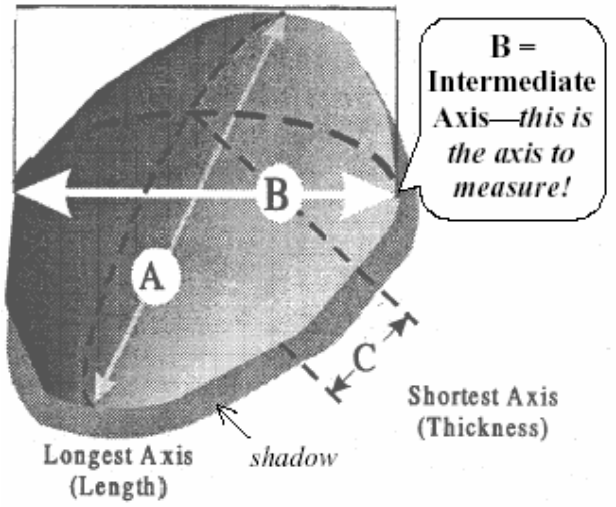

Size Class	Size Range (mm)	Description
Bedrock (smooth)	> 4000	Smooth surface rock bigger than a car
Bedrock (rough)	> 4000	Rough surface rock bigger than a car
Boulders	> 250-4000	Basketball to car size
Cobbles	> 64-250	Tennis ball to basketball size
Gravel (coarse)	> 16-64	Marble to tennis ball size
Gravel (fine)	> 2-16	Ladybug to marble size
Sand	> 0.06-2	Smaller than ladybug size, but visible as particles - gritty between fingers
Fines	< 0.06	Silt Clay MucK (not gritty between fingers)
Wood	Regardless of size	Wood & other organic particles
Other	Regardless of size	Concrete, metal, tires, car bodies etc. (describe in comments)

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FIELD PROCEDURE: CANOPY CLOSURE (single point)

EQUIPMENT NEEDED:

- spherical densiometer (in small wooden box)
- knowledge of cross-section transect for your reach (from map, written instructions, or verbal directions)
- data sheet, clipboard, pencil

Perform this procedure in January and August. Comparing the two annual readings will give some idea of the amount of cover that is provided by conifers, since the deciduous trees will lose their leaves by January. One person can perform this procedure.

1. Take this reading along your cross-section transect, in the middle of the wetted channel. **Do not perform this procedure in January if flows are too high for you to be safe.** If bushy streamside vegetation would get in the way of viewing canopy cover through the densiometer, you may move your location by up to six feet, as long as you remain in the wetted channel. Record any deviations on your data sheet.

2. Face downstream & open the densiometer. Hold it about 12" in front of you and at elbow height. The top of your forehead should be visible in the mirror but not the grid area. Close one eye and get your sighting eye in line with the grid centerline. Make sure the densiometer is level by getting the bubble inside of the circle. You will have a "fish-eye" view of the riparian canopy cover. Maintain this position while you count.

3. There are four dots in each square of the grid. Count either the dots that are more than half shaded or less than half shaded, depending on which is easier to count. (See sample diagram.) Count systematically, from top row to bottom row, left to right.

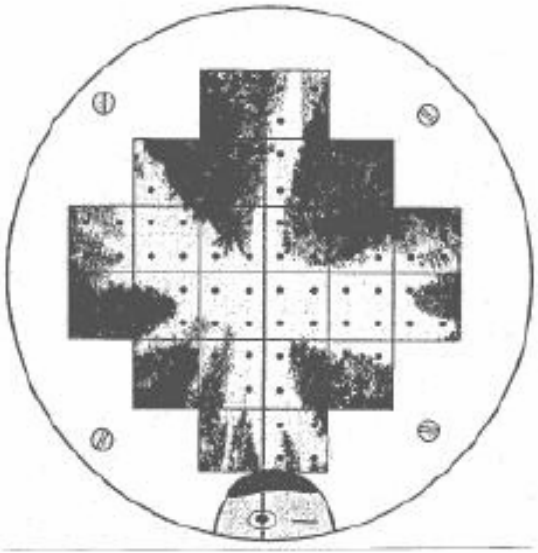
   Anything that shades the dots counts as shade, including tree stems, bushes, etc.

4. Record the number of **shaded** dots on your data sheet in the box marked "Dn". **If you counted unshaded dots, subtract that number from 96.**

5. Interference factors:
   a) **Sun glare:** Block the reflection using a finger on your free hand.

   b) **Wind in the branches:** Try to make your count between gusts. If this is not possible, use your best judgement.

6. Repeat this procedure facing toward the right bank, upstream, and left bank, turning 90° each time and rotating your body around the spherical densiometer (i.e., trying to keep the densiometer in the same spot). This gives you a representative look at canopy cover from all aspects of your site. ("Left bank" and "right bank" are your left and right while facing downstream.) Record the number of **shaded** dots for each direction in the boxes marked "RB", "Up", and "LB".



Sample spherical densiometer reading.
The above example shows 48 shaded points.
(From Pleus & Schuett-Hames, TFW 1998)

7. If possible, have someone else or the same person take the canopy closure readings again, and average them on your data sheet.

8. In the "Sampler's Initials" box to the right of the data boxes, put <u>all</u> the initials of <u>one</u> sampler taking responsibility for the data. If more than one person worked on this data, put the initials of the person with the most experience or knowledge.

9. The office computer will calculate the % shade, but if you want to calculate it yourself, add the four numbers and multiply by 0.26.

FIELD PROCEDURE: CANOPY TYPE PERCENTAGES (Reach-Wide)

EQUIPMENT NEEDED:

- data sheet, clipboard, pencil

In this procedure you'll estimate how much of your reach is under the cover of trees, both coniferous and deciduous. This is done in August, when the deciduous trees have leafed out.

1. Visualize your entire 100' x 100' square reach. (It may help to be in the middle of the reach or to walk the channel.) Look at the overstory canopy cover (the highest level of tree branches) in this area, and imagine that you were looking down on this canopy from an airplane. You would possibly see sections of conifer canopy, sections of deciduous canopy, and sections of no canopy (where you can see right down to the ground or bushes).

2. Imagining this view from the sky, estimate the percentage **of your entire reach area** over which the canopy is covered by conifer trees, in one of the following three classes: 0-5%, 6-50%, 51-100%. Mark the appropriate class on the "Conifer" line on your data sheet.

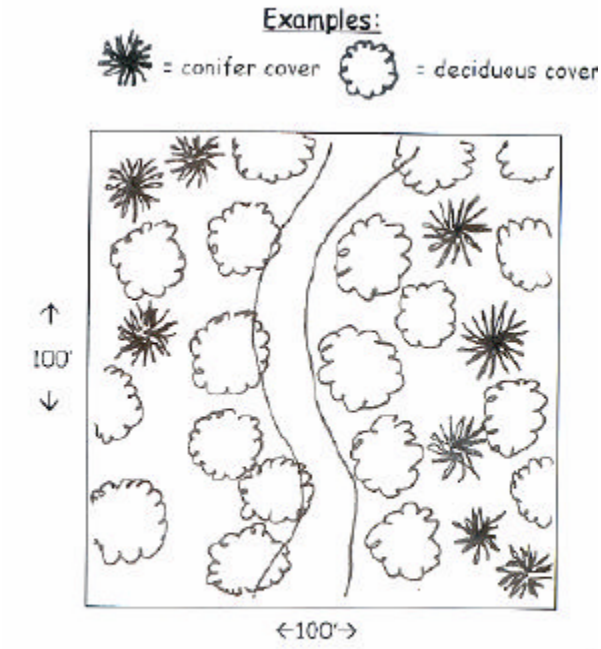
3. Estimate the percentage **of your entire reach area** that is covered by deciduous trees, in one of the following three classes: 0-5%, 6-50%, 51-100%. Mark the appropriate class on the "Deciduous" line on your data sheet.

4. If there is a portion of your reach that is not under tree cover, your percentages will not add up to 100%. See the examples on this page for guidance.

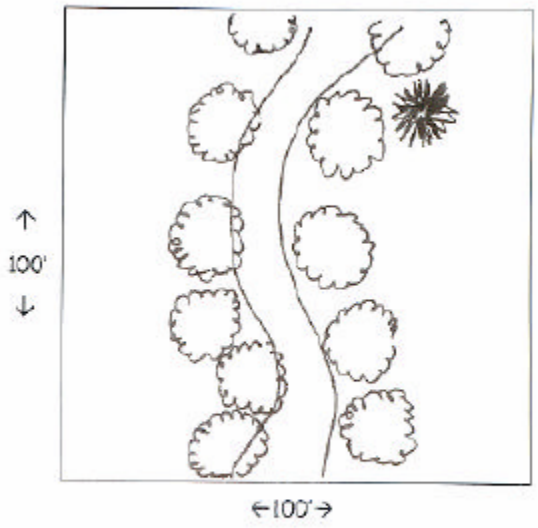
5. If in doubt, consult your fellow team members. Have them make their own estimates before sharing yours.

6. In the "Sampler's Initials" box to the right of the data boxes, put <u>all</u> the initials of <u>one</u> sampler taking responsibility for the data. If more than one person worked on this data, put the initials of the person with the most experience or knowledge.

(See examples on next page)



% conifer cover = 6-50%
% deciduous cover = 51-100%



% conifer cover = 0-5%
% deciduous cover = 6-50%

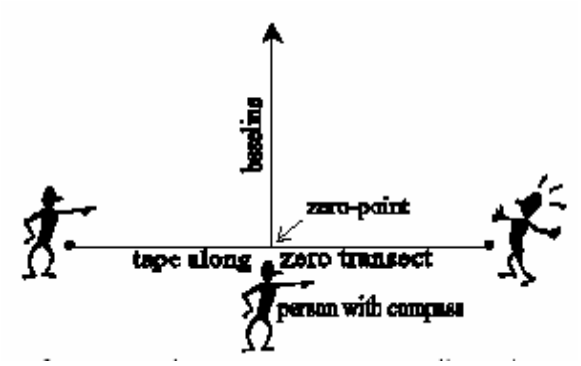
FIELD PROCEDURE: CONIFER STEM COUNT

EQUIPMENT NEEDED:

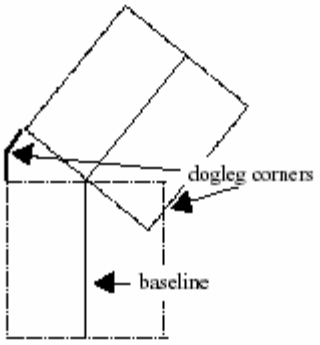
- reach map to determine reach boundaries
- 3 measuring tapes
- string
- flagging
- stakes
- data sheet, clipboard, pencil

You will count conifer stems, no matter what size or species. (You can generally stop counting at 61 stems[1]). Perform this count in January, once every 5 years or whenever there are significant changes in your reach. Three to six people can conduct this count most efficiently.

1. Establish the boundaries of your 100' X 100' reach, using your reach map to guide you (see Reach Map protocol). If these corners don't have permanent markers, you will want to temporarily mark them with flagging or stakes. To do this, have one person stand at the zero-point of your baseline with a compass and reach map. Sight in a direction perpendicular to your baseline, and send two people off in either direction along this "zero transect," with flagging tape, stakes, and either end of a measuring tape. Direct them as they walk out to their corners, where they will place flags. (See diagram.) If possible, leave the tape along the ground and wrap the ends around the stakes, to clearly indicate the "bottom" end of the reach. (You may have to secure the tape on either bank of the stream to keep it from getting dragged in the water.) Repeat this procedure at the far end of the baseline to establish the "top" end of the reach. Then, if possible, connect the corners in the lengthwise direction using another measuring tape, a string line, etc. That way you will have your reach borders clearly marked out.



2. If your reach is not square, you will need to mark the dogleg corners as well. This gets a bit tricky, as the following diagram indicates:



3. If you don't have the outside boundaries laid out with a tape or string, flag them by having two people start at adjacent corners and call out or signal while walking toward each other, flagging along the way.

4. Have two people stand at either corner on <u>one</u> side of the stream.

[1] If your reach is larger than a 100' X 100' square, your "top-count" number will need to increase proportionately. For example, if your reach is 200' X 200', your top-count number will be 241 (because your reach is 4 times larger than the standard reach, and 60 X 4 = 240). However, if you are monitoring a stream with a wide channel that takes up a large portion of the reach, you may have to adjust your top-count accordingly. When in doubt, consult Streamkeepers staff or just count them all!

5. Walk toward each other, zig-zagging as needed to cover the area between the stream and your outside boundary line. Count <u>all</u> the conifers in this area, no matter what size or species, until you meet and have counted all the conifers on one side of the stream (unless there are more than 60 stems – see below).

6. Repeat this procedure on the other side of the stream (unless there are more than 60 conifers already – see below). Or, with four people, you can cover both sides of the stream at the same time.

7. Once you reach 61 stems, you can stop counting[1].

8. Total your count and enter the number (or ">60" if there are more than 60 stems[2]) on your data sheet. If there are no conifer stems, enter a zero.

9. In the "Sampler's Initials" box to the right of the data boxes, put all the initials of one sampler taking responsibility for the data, even if all you wrote was a zero. If more than one person worked on this data, put the initials of the person with the most experience or knowledge.

[2] If your top-count is greater than 61, change what you write on the data sheet accordingly. In the example from Footnote 1, if you reached 241 trees, you'd write ">241" on the data sheet.

FIELD PROCEDURE: WATER CHEMISTRY

EQUIPMENT NEEDED:

- Hach 2100P portable turbidimeter
- YSI-60 pH meter
- YSI-85 multimeter
- watch with second hand
- sample collection bottle with screw top
- squirt bottle of purified water
- box of lint-free tissues
- ziplock bag
- 8 extra AA alkaline batteries for YSI-60 and 85 meters, and turbidimeter.
- approximate altitudes of your reaches
- data sheet, clipboard, pencil

PROCEDURE:
One person can perform these tests.

Where to sample: In this procedure, sampling consists of filling one sample bottle that will be used for the turbidity test, and then dipping the two probes in the stream. Pick an area where the stream is flowing and appears to be well mixed. ***Do not sample downstream of where your team has disturbed the bottom.*** Get as far away from the banks as you can, and try to sample in the thalweg (the deepest part of the channel).

Note on clean rinse water: Whether it's called "Purified Water" or "Distilled Water" or "Deionized Water," for our purposes it's the same stuff!

Field Replicates: Our quality control plan requires that at one of your team's reaches (even if your team samples more than one stream) you take a second set of readings for all chemical tests. Such field replicates give an indication of how much variability there is in the equipment, sampling techniques, and environment. Every monitoring session, your team leader should:

1. Determine if replicate measurements need to be made during the trip per directions from county staff.

REPLICATE DEVIATION & QA

Our Quality Assurance (QA) plan, on file with the state Dept. of Ecology, requires us to take replicates in order to check the accuracy of your data. If your team's replicate for a given parameter differs widely enough from the original sample, we have to label ALL the data for that parameter for your team for that session as "questionable" or "unacceptable." To avoid this:

Compare your replicate results to your original samples. In general, if they vary by more than 5% or one increment unit, you should do further sets of replicates until you have two sets that agree. Then label the first of those sets your "sample" and the second your "replicate."

Increment units are the units in which you take readings for a given parameter. For the others, it's whatever increment in which you record your readings, e.g., 1 NTU for turbidity, 1% for DO saturation, etc.

2. If so, perform each chemical test a second time. Perform the second test as soon as possible after the first, from the same sample bottle (turbidity tests) or in the same spot (YSI-85 and 60 meters). You do NOT need to recalibrate between tests.
3. Record and initial the results on the replicate section of the data sheet.

INITIAL PREPARATION OF INSTRUMENTS:

1. ***Hach turbidimeter:***

   a) The meter is water-resistant but not waterproof. Try to keep it as dry as you can. Close the cover when not in use.

   b) Turn the meter on to the lowest range to begin a ***warm-up***. If the "LOW BATTERY" light comes on the screen, you must replace the batteries before use.

   c) Be sure the "signal average" and "auto-range" features are enabled, indicated on the display.

2. ***YSI-60 pH Meter:***

   a) Turn on the YSI-60 pH meter to start its 15-minute warm up. All segments of the display will be activated for a few seconds. Eventually, pH and temperature will be displayed. If "LO BAT" is displayed, then you will need to replace the batteries. If pH and temperature are not displayed, press "MODE" until you get to the right display on the screen.

   b) Set the meter down in a shady spot during this warm-up period.

3. ***YSI-85 multimeter:***

   a) Turn on the meter. The instrument will activate all segments of the display for a few seconds, then go through a self-test procedure that will last a few more seconds. A number will be displayed, along with the letters "CEL." That number should be between 4.8-5.2. If not, report the number on the data sheet and to the office staff.

   b) If the unit displays "Err" at this point, try turning the unit off and back on again. If it displays "LO BAT," replace the batteries, and discard the old ones. If it displays other error messages, you will not be able to use the instrument—record the problem and let the staff know about it as soon as possible. If it displays number readings, "rcl," or "ErAS," the meter is functioning properly.

   c) Remove the probe from the calibration chamber on the side of the meter. Shake any water off as you would shake down a mercury thermometer. If the sponge inside looks dry, add a few drops of water, let it soak in, and then pour off the excess. Examine the probe. All holes should be clean of debris, and the gold cathode on the end should be shiny. The plastic membrane over the cathode should not be loose, wrinkled, damaged, or dirty. There should be no bubbles larger than 1/8" under the membrane. Rinse, if needed, with purified water. If problems persist, note these on your data sheet and continue as best you can with the procedure. Replace the probe in the calibration chamber, inserting it all the way.

   d) Set the unit down in a shady spot on the bank for 15-20 minutes while the readings stabilize.

4. ***Air-temperature thermometer:*** You'll want to hang the thermometer in a shady spot on the bank with good air circulation, preferably at about eye height, until its temperature stabilizes at the air temperature. We suggest you read the thermometer after taking the turbidimeter readings, but before taking the YSI-meter readings, so that you don't pack up and leave without it!

COLLECTING A WATER SAMPLE FOR NUTRIENT AND TURBIDITY TESTS:

1. Open the plastic screw-top sample-collection bottle and rinse it three times in the stream, facing upstream, at a place where your team

has not disturbed the bottom--preferably at mid-stream and mid-depth.

2. After rinsing, insert the bottle into the stream upside-down in the middle of the water column. Invert it so that water almost fills it, but not quite. If possible, cap the bottle underwater. Otherwise, remove the bottle from the water with the bit of air space at the top, and then cap it. If the bottle comes out full, reinsert it and try again. Do NOT pour water off the top once the bottle is out of the water. *(For a diagram of the procedure, see Figure 2 of the Grab Sample protocol.)*

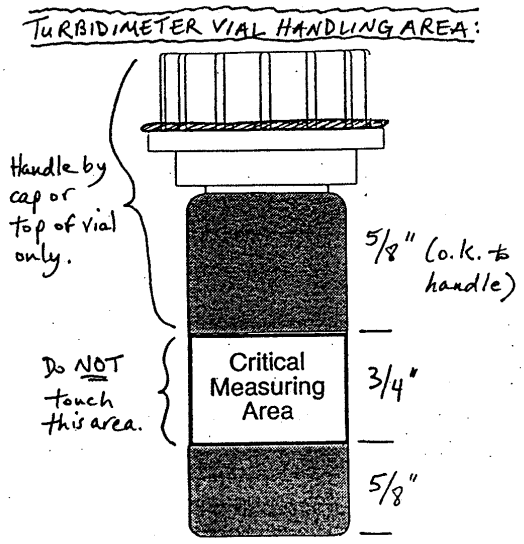
SAMPLER'S INITIALS

For <u>each</u> test that you perform in this protocol, there is a "Sampler's Initials" box to the right of the data boxes. Be sure to put <u>all</u> the initials of <u>one</u> sampler taking responsibility for the data, usually the sampler with the most experience.

<u>TURBIDITY MEASUREMENT (Hach 2100P portable turbidimeter):</u>

<u>Handling the vials:</u> Inside the meter will be sample vials and three Gelex reference vials—marked on the cap between 0-10 NTU, 0-100 NTU, and 0-1000 NTU. The instruction booklet in the case has the most recent values recorded for the Gelex standards on the back cover.

1. ***Do not <u>ever</u> open the reference vials*** *or unscrew their caps.*
2. ***Take care not to scratch or get dirt on <u>any</u> of the vials.*** Do not put them down anywhere except inside the meter case.
3. When moving closed vials, ***hold by the caps only.*** When opening, closing, or sampling, ***hold the glass portion of the vials in the area just below the neck,*** which is outside of their critical measuring area (see diagram below). When possible, hold the vial with a Kimwipe.



<u>Taking the readings (with meter still on after the warm up period):</u>

1) ***Record last calibration date:*** The latest full-range calibration date should be marked on a sticker on the face of the meter. Record it on your data sheet.
2) ***Check calibration:*** Take the 0-10 NTU sealed Gelex reference vial out of the box marked "turbidity standards kit", holding by the cap or upper part only. Clean the critical measuring area with a lint-free tissue. Place this vial in the meter's chamber, aligning the white diamond on the vial with the plastic notch in the chamber collar. In the space marked "Field Calibration Check," record the # of NTUs listed on the back cover of the manual for the 0-10 NTU Gelex standard, and the reading on the meter to the nearest 0.01 NTU.
3) Repeat step 2 above with the 0-100 NTU Gelex reference vial.
4) ***Calibration check problems:*** If the above reading differs from what's written on the manual by more than 10%, try to improve the reading by cleaning the vial again or warming

it if it keeps fogging up. If reading is still more than 10% off, continue on with the following steps—the information you collect may still be useful.

5) ***Fill the sample vial (remember to hold by the upper part only):***

   a) Discard any water in the turbidimeter's sample vial.

   b) Thoroughly agitate the sample in the collection bottle. Immediately fill the sample vial 1/4-1/3 full and shake with the cap on loosely. Empty the sample vial. Agitate the collection bottle and rinse the vial again. Then agitate the collection bottle and fill the vial to just below the neck. Retighten the vial's cap.

   c) Holding the sample vial ***by the cap*** and wipe it dry with a lint-free tissue.

6) ***Take the readings:***

   a) Gently invert the vial several times to mix, being careful not to introduce bubbles.

   b) Quickly insert the sample vial in the chamber, aligning the diamond on the vial's side with the notch on the well's collar ring.

   c) Press the "Read" key. The instrument will measure for about 10 seconds and then display a set of readings by flashing them on the screen. The final reading is steadily displayed after the set of readings. Record the turbidity on the datasheet.

   d) Repeat steps 5 & 6 twice more, for a total of three readings. If readings vary greatly, take more readings until you have three that are close (one unit or 10%, whichever is greater). Record these three readings.

7) ***Clean and store:***

   a) Turn off the meter until you get to your next reach.

   b) Holding the sample vial by the portion just below the neck, rinse it as follows:

      i) Pour out the sample water.

      ii) Fill 1/4-1/3 full with purified water.

      iii) Screw the cap on loosely.

      iv) Shake upside down.

      v) Empty the vial, twisting so that water rinses the sides.

      vi) Repeat this rinsing one more time.

      vii) Refill the sample vial with purified water. Recap and place in the trough.

   c) Close the meter.

   d) Rinse the plastic sample collection bottle with stream or purified water, by filling 1/4 full, screwing the cap on loosely, shaking, and pouring out while swirling. Repeat twice more. Recap and store.

AIR-TEMPERATURE MEASUREMENT:

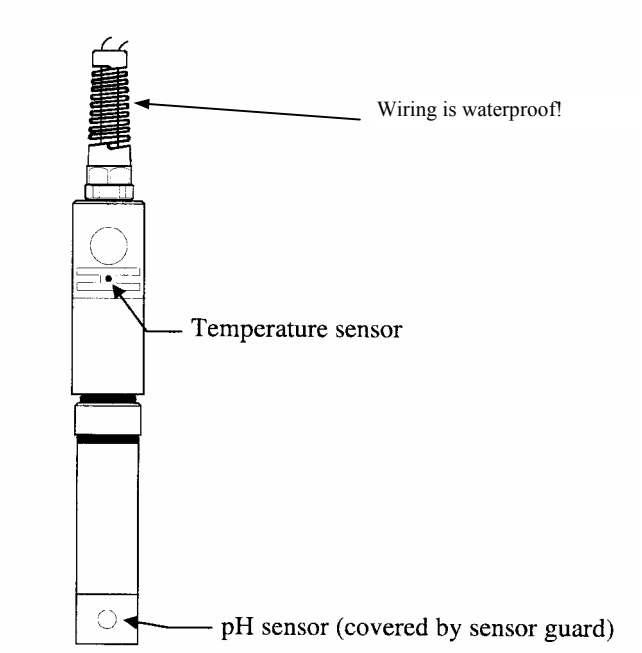
First make sure the sun hasn't been shining on the thermometer. Estimate the reading to the nearest °F. Wait 30 seconds and estimate again. If the reading hasn't changed, record it on your data sheet. If the reading has changed, jot down the second reading, leave the thermometers hanging, and read it again after finishing the YSI readings. Record the average of the two readings on your data sheet.

pH MEASUREMENT (YSI-60 METER):

Note: County staff will calibrate the pH meter prior to checkout. The program may require occasional checking of calibration with a pH buffer.

1) After the YSI-60 pH meter has warmed up for at least 15 minutes, get a screen that shows pH and temperature. You may need to press **"MODE"** repeatedly until this screen appears.

2) Remove the probe from the transport chamber of the meter, and insert the probe in the water. **Make sure the pH sensor at the end of the probe and the temperature sensor near the top of the probe are both immersed** mid channel in the stream.



3) Allow enough time for the meter readings to stabilize. It may take several minutes. Take your reading when the meter stays within a range of 0.1 pH unit (plus or minus 0.05 pH units) for 30 seconds. Then record pH to the nearest 0.1 pH unit.

4) Shake off the probe, inspect it for dirt, and insert it back into the transport chamber so that the pH sensor won't dry out.

5) **Turn off the meter**.

DISSOLVED OXYGEN, TEMPERATURE, AND SPECIFIC CONDUCTANCE MEASUREMENTS (YSI-85 METER):

NOTE: The YSI-85's buttons are slow to respond, so wait a few seconds after pressing any button to give the meter time to react. Otherwise, you may skip over the screen you want…

1. ***Erase the meter:***

   a) Press the MODE button as many times as needed for "ErAS" to appear on the screen.

   b) Press the DOWN ARROW and ENTER buttons simultaneously for approximately 5 seconds.

   c) When "DONE" flashes on the screen for 1-2 seconds, the data has been erased, and the meter will automatically return to normal operation.

2. ***Calibrate the meter:***

(NOTE: Keep the meter in the shade while calibrating.)

a) After the meter has been on with the probe inside for 15-20 minutes, get to a screen that shows a figure in % near the top. (Press the MODE button repeatedly if you need to change screens, leaving a second or two after each pressing). This is the DO (dissolved oxygen) % saturation screen.

b) Press both UP and DOWN ARROW buttons at the same time. The next screen will prompt you to enter the altitude to the nearest hundreds of feet, using the UP or DOWN buttons to change the number. For instance, 2 would mean 200' elevation. (If you don't know your exact altitude, take your best guess, and record your guess on the data sheet. Most downstream reaches are near sea level.) Set the proper elevation, then press ENTER once.

c) The meter will now show CAL in the lower left of the display. Make sure the % reading

stays within a range of one full % for 30 seconds, then press ENTER once. The display should read "SAVE," and the instrument is now calibrated for DO.

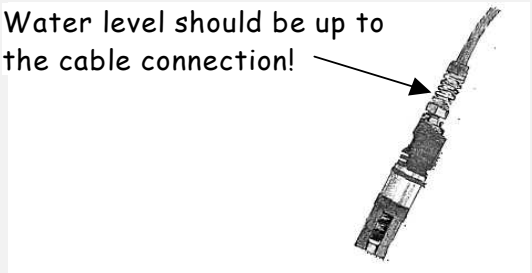
d) The temperature probe needs no calibration. The conductance probe is calibrated at the office, and the latest calibration date should be written on a sticker on the back of the meter. Record that date on your data sheet.

3. ***Record the time*** on your data sheet, to the nearest minute.

4. ***Insert the probe in the stream:*** Have the screen on the meter set to DO % Saturation. Standing downstream or to the side of the probe, hold it in the current, facing the probe upstream, in a place with steady flow, adequate depth, good mixing, and no surface turbulence. If the current is slow, hold the probe halfway down in the water column and stir back and forth so that water moves over it at the rate of at least 1 foot/second; but do not create bubbles.

HOW TO HOLD THE PROBE

Get the whole probe underwater! It won't break! The YSI-85 probe has sensors at various positions, and ***all*** of those sensors need to be completely under water.



5. ***Save the readings:*** Wait for the numbers to stabilize, then press ENTER and hold for 2 seconds. The meter will flash SAVE on the display along with a site number, indicating that it has saved the readings for <u>all</u> parameters. Shake off the probe, inspect it for dirt, and put it back into the calibration chamber.

6. ***Record the readings:*** Back on the bank, press MODE repeatedly until "rcl" (recall) is displayed on the screen. The number below "rcl" should be the same site number the meter gave when it saved your data. (If not, try to get it to show you that site number, or go back to Step 2!) Then press ENTER successively to get the following readings, in the following order, which you should record on your data sheet:

   a) ***Temperature***: Record to the nearest 0.1°C.

   b) ***DO % Saturation:*** Record to the nearest 1%.

   c) ***DO Concentration:*** Record to the nearest 0.1 mg/L.

   d) ***Specific Conductance:*** You will see a screen with a figure in "µS" or "mS" and the "°C" symbol ***flashing***. Record to the nearest whole number of µS (microSiemens). If the reading is in mS (milliSiemens), multiply by 1000 (i.e., move the decimal place 3 places to the right) to convert to µS to record on the data sheet.

COMMON SENSE AND CONDUCTIVITY

Stream conductance is rarely lower than 20 µS. If your readings are lower than this, you'll need to troubleshoot:

- If the reading is 0.0 or 0.1, you might be reading the salinity ("ppt") screen rather than the proper conductivity screen; if so, scroll through the screens again (by pressing ENTER) until you get to the right one.
- You might not have held the probe completely underwater. Try taking another set of readings.
- The readings might be in mS rather than µS.

7. ***Erase the data from the meter*** once you have entered it on your data sheet:
   a) Press the MODE button as many times as needed for "ErAS" to appear on the screen.
   b) Press the DOWN ARROW and ENTER buttons simultaneously for approximately 5 seconds.
   c) When "DONE" flashes on the screen for 1-2 seconds, the data has been erased, and the meter will automatically return to normal operation.
8. ***Turn off the meter.***

ALTERNATIVE CALIBRATION AND COLLECTION PROCEDURES FOR POOR CONDITIONS:

If the weather is severe and you wish to minimize your time on the creek, you may turn on and prepare the turbidimeter and YSI-85 multimeter at home. If the stream is difficult to wade or lean over, or if the weather is inclement, you may draw a water sample from the stream and perform the tests on the bank or in a vehicle. Use the plastic tub to collect the sample, preferably at mid-stream and halfway-depth. If possible, fill the tub completely and close the lid under the water--this will prevent atmospheric oxygen from being introduced into the sample. Try to let no more than a few minutes lapse between collecting and testing, and note the collection procedure and delay time on your data sheet. Perform the Dissolved Oxygen/ Temperature/ Conductivity test as soon as possible, followed by the pH test.

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FIELD PROCEDURE: BENTHIC MACROINVERTEBRATE SAMPLING

Benthic macroinvertebrates are animals without backbones, such as insects, worms, scuds, and mollusks, which live at the bottom of streams and are visible to the naked eye. Volunteers collect them once a year during the regular fall monitoring session, Sept. 15–Oct. 15. Once collected, they are professionally identified and tallied. However, volunteers are welcome to examine the invertebrates before or after preserving them—see last part of this protocol.

EQUIPMENT NEEDED (items with an * are in the regular bin rather than the "bug bin"):

- 1 D-frame kicknet with 1'X2' metal file hanger
- 1 500-micron sieve
- 2 rubber dishpans
- weeding fork to disturb substrate
- *timepiece with second hand
- 2 angled-spout wash bottles (one for water, one for alcohol)
- 2 squirt bottles (one water, one alcohol)
- macroinvertebrate handling tools:
  - plastic spatula
  - forceps (tweezers)
  - magnifying glasses
  - scrub brushes
- sample jars with screwtop lids
- alcohol
- electrical tape
- shallow white trays
- Field Key to Macroinvertebrate Identification
- labels
- ziplock bags—small and large
- 3 washers with flagging tape attached
- permanent marker
- *reach map for each reach
- *100' tape
- *data sheet, clipboard, pencil

WHY SAMPLE MACROINVERTEBRATES?*

The best way to assess the health of a watershed for living things is to look at those living things. Undisturbed watersheds in the Pacific Northwest contain a marvelous variety of benthic macroinvertebrates, representing a smorgasbord of shapes, sizes, survival strategies, and adaptations. Human activities that interfere with natural processes in a watershed have a definite and predictable impact on the types and numbers of invertebrates that live there.

Many invertebrates are just as sensitive to changes in their environment as salmon. We tend to be more interested in fish than invertebrates, but there are several good reasons to sample invertebrates rather than or along with fish:

- It is easier and less intrusive to the environment to sample invertebrates.
- Whereas anadromous fish are impacted by a variety of factors such as ocean conditions and fishing pressure, stream invertebrates are primarily impacted by activities within their watershed.
- Since invertebrates are an important food source for fish (and other wildlife), sampling them measures an environmental component with a direct impact on fish.
- Undisturbed streams have such a great variety of invertebrates that sampling can reveal subtle disturbances over space and time.

HOW DO MACROINVERTEBRATES PROVIDE A "BLOOD TEST" OF A WATERSHED'S HEALTH?

We can assess the biological health of a stream by looking at the types of invertebrates that either thrive or do not thrive in it. If only a few types of invertebrates live there, or if the invertebrates are primarily ones that adapt well to streams that are unnaturally warm, cloudy, unstable, or de-oxygenated, there is some kind of problem present.

A group of teachers and students at the University of Washington (now spun off as the nonprofit group SalmonWeb) have developed a means to sample invertebrates in a uniform way, identify and count them, and then perform some calculations to assess stream health. The calculations measure such things as:

- The total variety and balance of life forms present (a.k.a. biodiversity)
- The variety of types of mayflies, stoneflies, and caddisflies—invertebrates that form an important part of the diet of salmon and trout, and that respond in complex ways to different human disturbances
- The variety or number of invertebrates that are known to adapt very well or very poorly to human disturbances
- The variety of invertebrates that need clear spaces between rocks or stable habitat for a long time span.

By sampling at many sites, both disturbed and undisturbed, these scientists were able to develop a set of calculations that give a good indication of the biological health of streams and their surrounding watersheds. These metrics are known as the Benthic Index of Biological Integrity (BIBI).

The macroinvertebrate samples you collect will be professionally identified, and the counts will be entered onto a computer spreadsheet that calculates the BIBI for each sampled reach. The BIBI yields a single number on a scale (much like a test score), along with a description of that number, ranging from Excellent to Very Poor (much like a report card). Thus, the BIBI enables us to transform information about invertebrate populations into a generalization about stream health. It is a powerful analytical tool.

*(*Much of the above discussion has been adapted from Leska Fore, "Measuring the Effects of Urbanization on Bellevue Streams," a report prepared for City of Bellevue Utilities Department, March 1999.)*

WHEN TO SAMPLE

In order to provide comparable information, macroinvertebrate sampling must occur between September 15 & October 15 each year. In extraordinary circumstances, it may be possible to sample later in October, depending on flow and water levels. If for some reason your team is genuinely not able to collect macroinvertebrate samples during the fall monitoring session, contact county staff.

NOTE: If water levels are high during or after a heavy rain, it is best to wait until the water level recedes, for both safety and data-quality purposes.

FIELD PROCEDURE:

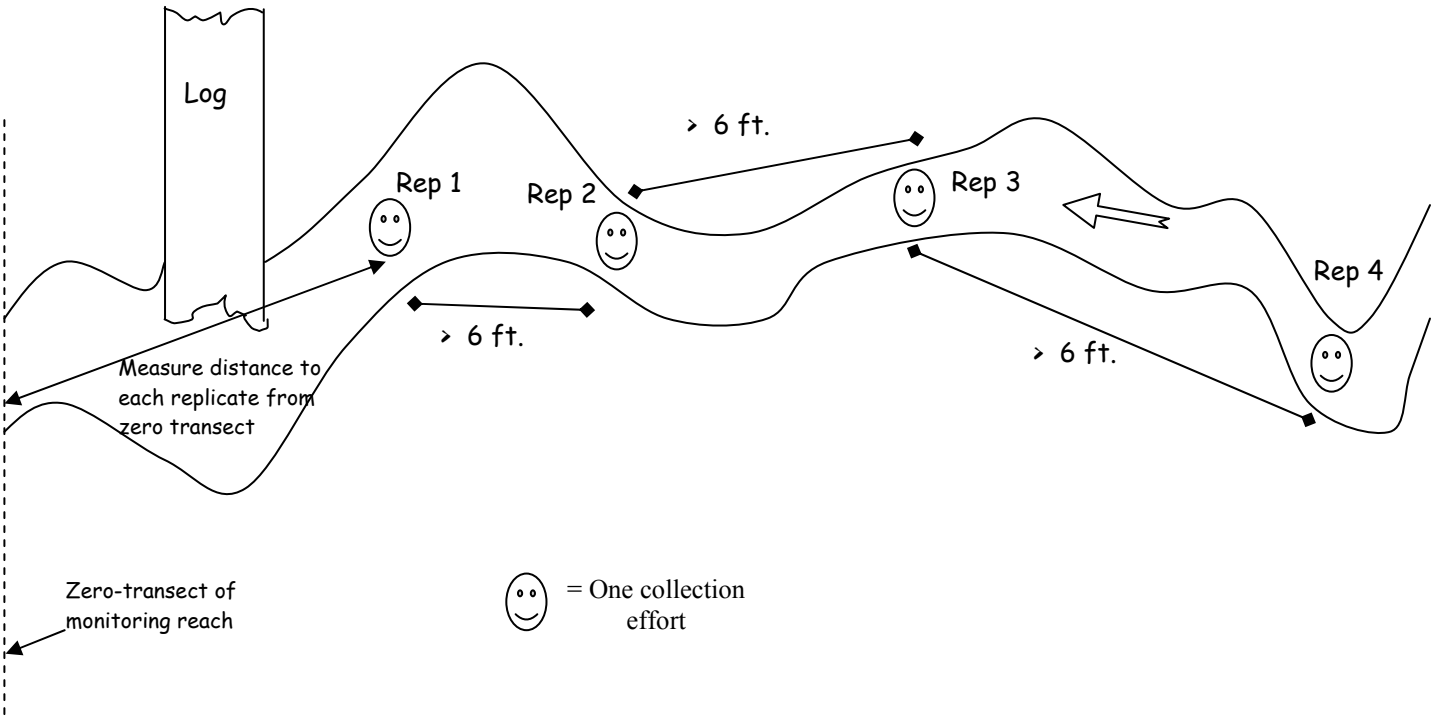
1) ***Overview of sampling.*** You should sample within or near your established monitoring reach. You will need to collect ***four replicates,*** putting the D-frame net down in four separate riffles. Riffles should be located greater than 6' apart.

2) ***Select sampling sites.*** Find riffles (fast, turbulent water moving over gravel or cobble substrate) within the main flow and near the middle of the stream, from 4-16" deep. The best substrate would be 2-4" rocks, with smaller pebbles underneath (avoid substrates with rocks larger than 12" in diameter). Look for an area with the best overhead canopy and riparian vegetation that you can find. Depth, flow, and substrate type should be similar for all sampling locations. Try to sample at least 165' upstream or 660' downstream of a bridge or other large human-made structure, even if you have to go outside of your reach to do so.

3) ***Begin downstream and move upstream.*** Avoid disturbing terrestrial vegetation overhead or upstream of your sampling site, to avoid getting terrestrial insects in the sample.

(next page)

Location of 3 of 4 bug samples



4) Collect a replicate:

a) Frame out sampling area, and place the metal rectangle and net on the selected spot with the opening of the nylon net facing upstream and the collection cup stretched out behind. Hold the frame firmly on the stream bottom. The current should move directly into the net.

b) Lift the larger rocks resting within or beneath the frame and, holding them in the water in front of the net, brush off any crawling or loosely attached organisms so that they drift into the net. After "cleaning" the rocks, place them in a dishpan. Once these rocks have been removed, the frame should be squarely on the stream bottom.

c) Once the larger rocks are removed, disturb the substrate vigorously with the trowel for 60 seconds, to a depth of about 4" (You should dig vigorously enough to be breathing hard). Organisms and detritus should wash into the net. Allow the disturbed material to float into the net opening.

d) Let water flow through the net for a few seconds and then lift the sampler out of the water: keeping the open end pointing upstream, tilt it up out of the water to help wash organisms into the collection cup.

e) At this point the group can split up. One or more people should put a little alcohol in the sample collection bottle and begin examining the large rocks collected in the dishpan, using a magnifying glass, if necessary. Using a brush or forceps, gently move any organisms found into the sample bottle. Place cleaned rocks back in the stream in the area of the sampling site. When all rocks have been cleaned, pour the water from the dishpan through the sieve bucket. Rinse the pan, agitate, and pour again. This should filter out any invertebrates that washed off the rocks.

f) Meanwhile, the other samplers should attend to the net sampler. Wash all objects caught on the inside of the net into the sieve bucket:

i) ***With the opening out of the water,*** rotate the net around in the water so that most of the objects inside wash into the bottom of the net.

ii) You may use the decanter or bucket to pour unfiltered ("dirty") water into the net from the outside, or you may pour filtered ("clean") water down the sides of the net from the inside. (Make clean water by filtering it from the "dirty" bucket, through the "dirty" sieve, into the "clean" bucket.)

iii) Invert the net over the sieve bucket and gently tap the outside to dislodge debris. Only allow small rocks to fall into the sieve. Large rocks must be removed and washed into the sieve directly from the net. Use a wash bottle with "clean" water to spray the bottom and sides on the inner net. Most of the organic matter should enter the sieve with the water.

iv) When most of the debris has been washed into the sieve, turn the net inside out while holding it over the sieve bucket. Use the wash bottle with "clean" water to wash material into the sieve bucket.

v) ***Pick out large debris*** (sticks and leaves) from the material in the sieve bucket. Using a magnifying glass and squirt bottle or tools, pick off any organisms and return them to the sieve or sample jar before discarding these pieces.

5) ***Collect three more replicates following the same procedure as in #4 above.*** Composite all four replicates in the sieve bucket between riffles. Make sure bugs are not escaping the bucket. Fast moving stoneflies and others can be removed and placed into the sample bottle. Remember to keep moving upstream. At the end, you will have placed the sampler down 4 times and will have collected 4 replicates, composited in the sieve bucket. Flag each sampled riffle with tape tied to a tree or by dropping a flagged washer into the riffle at each location where a sample is collected.

6) After 4 collections, **transfer the contents of the sieve bucket into the sample bottle**. You can get most of the contents of the sieve down at one end by dipping the sieve bucket at an angle in the stream. Use forceps, a spatula, and/or a squirt bottle to move the remaining contents of the clean sieve into the sample bottle. Tip the bucket over the sample bottle and use a wash bottle filled with alcohol to wash the material down to the bottle. Be very careful where you spray alchohol and to avoid breathing the fumes from the sieve bucket.

7) Fill the sample bottle *to near the top* with alcohol. Use a pencil to fill out one of the pre-printed labels with the date, stream, site ID, first initials and last names of samplers. Close the jar tightly and wrap the seal 2-3 times with electrical tape. (see example label below).

SAMPLE JAR Label:
9/15/2002
Lackawater Ck, LAK030,
J. Watergetter, S. Buggrabber

8) You now have flagging at each of your sampling locations. At each location:

a. Measure and record its ***direction*** (upstream or downstream) ***and distance from the zero-transect of your reach*** (to the nearest number of feet) in the appropriate boxes on your data sheet.

b. Measure and record the following information about ***the area in which you collected each replicate:***

   i. Using the stadia rod the average water **depth** at the spots where you dug that replicate (with the rocks removed), to the nearest tenths of feet.

   ii. The ***width*** of the riffle in the area where you dug, to the nearest tenth of feet.

   iii. The ***length*** of the riffle in the area where you dug, to the nearest number of feet.

c. ***Collect your flagging*** as you go.

9) ***Photograph*** your sampling sites in the following manner:

a. If all four replicates were taken from the same riffle sequence, one set of photos will suffice.

b. Replicates that were taken far apart or from areas that look very different should have separate sets of photos. Use your judgment here.

c. A set of photos consists of the following:

   i. A photograph of the riffle area itself, ideally showing some of the substrate; if the gravel is visible, try to

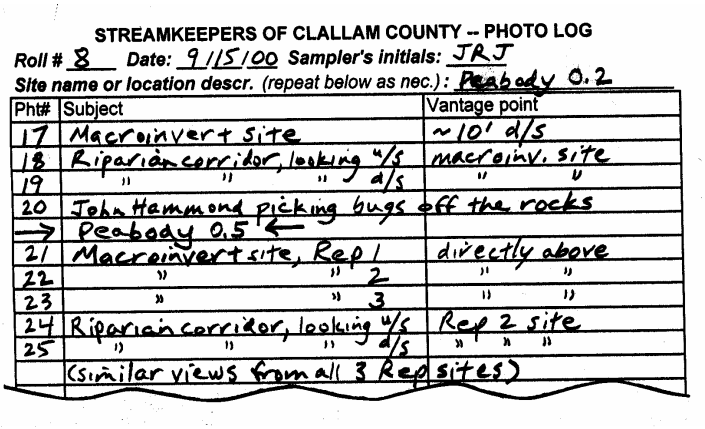
hold a familiar object near it to help gauge its size.

ii. Photographs of the riparian corridor taken upstream *and* downstream from the sampling area.

iii. If possible, take a photo of the team actually doing the sampling.

d. Complete the photo log for each photo.

Sample photo log:



STREAMKEEPERS OF CLALLAM COUNTY -- PHOTO LOG

Roll # 8 Date: 9/15/00 Sampler's initials: JRJ

Site name or location descr. (repeat below as nec.): Peabody 0.2

Pht#	Subject	Vantage point
17	Macroinvert site	~10' d/s
18	Riparian corridor, looking u/s	macroinv. site
19	" " " d/s	" "
20	John Hammond picking bugs off the rocks	
→	Peabody 0.5 ←	
21	Macroinvert site, Rep 1	directly above
22	" " 2	" "
23	" " 3	" "
24	Riparian corridor, looking u/s	Rep 2 site
25	" " " d/s	" " "
	(similar views from all 3 Rep sites)	

10) In the "Sampler's Initials" box to the right of the data boxes, put <u>all</u> the initials of <u>one</u> sampler taking responsibility for the data. If more than one person worked on the data, put the initials of the person with the most experience or knowledge.

11). If you would like to examine your samples, you may do so…

- …***after*** preserving them. Simply empty the contents of a jar into a dishpan and poke around, using a magnifying glass and the macroinvertebrate-handling tools. The laminated field key will help you to identify what was in your sample. When finished examining, return <u>all</u> contents (and the label!) to the jar, checking carefully for any hangers-on (stickers-on, actually, since they'll be dead by then!). At the same time, you could help the professional taxonomist by discarding rocks, twigs, leaves, etc., after inspecting them.
- …or, if you want the fascination of watching the critters move around, You may also examine your samples ***briefly before*** preserving them. To do this, empty the sieve contents into a dishpan, and add a little clean water. Keep in mind that if you keep them in the tray too long, the big critters might start eating the little ones, and you'll start losing your sample!

FIELD PROCEDURE: NOXIOUS WEEDS

EQUIPMENT NEEDED:

- picture booklet: Noxious weeds
- disposable camera
- photo log in field notebook
- flagging tape
- datasheet, clipboard, pencil

Noxious weeds are introduced plant species that are aggressive, invasive, and once established, difficult to control. Noxious weeds tend to crowd out native plants, causing environmental damage, economic losses, and even public health and safety problems. State law mandates control of some species.

Submit reports and updates as needed when you visit your quarterly monitoring reaches. Turn in reports a.s.a.p. This data will go directly to the Clark County Weed Board.

Feel free to turn in additional Noxious Weed Reports for any other infestations that you notice in your daily travels.

WEED OBSERVATIONS:

1. If you are doing quarterly monitoring:
a) Fill out a Noxious Weed Report only if you find new or advancing weeds.
b) On your master data sheet indicated whether you have completed a Noxious Weed Report for that site on that day. Put your complete initials in the "Sampler's initials" box, even if you did not find any new or advancing weeds, and thus did not complete a report.

2. On the Noxious Weed Report, fill out the date, your name, and the location (brief description). Circle a choice from 1-9 indicating property ownership. Fill in the landowner's name (check your site packet in the monitoring kit).

3. Estimate the density level for each weed that you find:

(1) Not obvious = one plant or very few
(2) Patchy = a few plants
(3) Easily seen = obvious at a first glance at the area
(4) Codominant = greater than 50% coverage
(5) Dominant = greater than 90% coverage

DON'T BE DENSE ABOUT DENSITY!
What you see out in the field may not fit neatly into these categories. But your purpose in filing this report is to alert the Noxious Weed board of possible problem areas, so don't sweat over which box to check off. For further descriptions of the density categories, see the following page.

4. On the sheet estimate the width and length of the patch of weeds for each type of noxious weed. Make your estimation in feet.

5. Take photos, especially if the weeds have advanced or are in bloom. Complete the photo log for each picture. In the picture, try to place an object of familiar size, like a pencil or compass, next to the plant.

Dominance Rating	Definition
1	It can be found by searching in and around other species. A dominance of "1" is not obvious.
2	It can be seen only by moving through the vegetation or by searching for it while standing in one place. A patchy pattern observed by moving through the vegetation rates a dominance of "2".
3	It is easily seen by standing in one place and glancing around, but it is not an obvious dominant. In a mixed stand, several species may fall into this category.
4	It is at least a codominant. It shares dominance relative to cover or is considered slightly subordinate to other species, native or introduced; for example: cheatgrass or Kentucky bluegrass in a rangegrass community or a mixture of weeds on abandoned farmland.
5	It dominates the site. It is dominant in the sense that it provides essentially total cover when viewed casually.

FIELD PROCEDURE: GRAB SAMPLES FOR BACTERIA AND NUTRIENTS

NOTE: Regular monitoring teams collect water samples quarterly. Samples are analyzed under a contract between Clark County and North Creek Analytical Laboratories in Beaverton, Oregon. Due to holding time restrictions, the collection of nutrient and bacteria samples needs to be coordinated with county staff to ensure prompt sample delivery to the lab. Restrictions may limit the available dates for quarterly grab sampling.

EQUIPMENT NEEDED:

- Fecal/Nutrient Sample Tracking Sheets—one per team per day
- Clipboard, pencils
- Directions to collection sites
- Sterile bottles, enough for each team's collection, plus replicates, plus a few more
- Watch to tell time
- Latex gloves
- Waterproof marking pen
- Thermometer
- Sampling wand to attach bottles to
- Screwdriver
- Large cooler to keep in car
- Portable cooler to carry to sites
- Ice to maintain temperatures below 39°F/4°C (preferably shaved ice from a seafood store)

WHY GRAB SAMPLES?

Microorganisms and nutrients are naturally present in streams, but humans can change both the quantity and nature of these inputs in a way that upsets nature's balance:

- Pathogenic (disease-causing) micro-organisms that humans or domestic animals introduce to water—including varieties of bacteria, viruses, and protozoans—can cause diseases in humans and animals alike, including salmonella, hepatitis, and giardia.
- Undisturbed streams generally contain less than 1 mg/L of nitrate-nitrogen (the part of the nitrate ion consisting of elemental nitrogen). Levels above 10 mg/L have been connected with Blue Baby Syndrome, reduced livestock vitality, and "brown blood disease" in fish.
- Build-up of free ammonia in the water can be toxic to fish under certain conditions, such as high water temperature and pH.
- Excessive inputs of nutrients (through fertilizers, livestock, or leaking septic tanks) to water can lead to eutrophication--a massive build-up and die-off of vegetative matter that takes up the available dissolved oxygen in the water and suffocates fish and the macroinvertebrates they depend on. When elevated levels of pathogens or nitrates are present, water quality is at risk.

One way to test for the presence of human-introduced pathogenic microorganisms is to focus on fecal coliform bacteria, which primarily live in the digestive systems of warm-blooded animals, aiding digestion. These bacteria, though not pathogenic themselves, are good indicators of human or animal waste contamination, which often carries other more harmful organisms that are harder to test for. Hence, Washington State water quality standards use fecal coliforms as the indicator of potential pathogenic conditions in streams. *However, since one form of fecal coliform bacteria does not have an animal origin, laboratories can test for one species particular to animals--Escherichia coli (E. Coli)--to confirm animal contamination. (WA state is considering switching from fecal to enterococci—we'll keep you posted on this.)*

- Neither bacteria nor nutrients can be accurately measured in the field. Volunteers will therefore collect samples for lab analysis where accurate determination of levels is required.

WHERE TO SAMPLE:

Quarterly samples for bacteria will be taken on each stream that volunteers monitor. In the case of an identified problem, county staff may request that additional sites be sampled.

WHEN TO SAMPLE:

During the year:

- Routine bacterial samples will be taken quarterly during the following times:
  - January
  - April or May
  - August 1 – September 15
  - October 5 – 31

  The volunteers will decide on what day to sample, taking into consideration the factors listed below. ANY proposed sampling date must be confirmed a week in advance with the Clark County staff to arrange lab pick-up. (NOTE: The lab does not take samples on weekends.) ***Notify county staff*** when you have scheduled a sampling date, and arrange to pick up the equipment.
- Non-routine bacterial and nutrient samples will be scheduled ad hoc in conjunction with county staff.

During the day: All samples must be collected starting no earlier than 6:00 a.m., and delivered to the Lab by 2:30 p.m. for processing.

FIELD REPLICATES:

Our quality control plan requires that at each sampling site per year, a second sample be collected for a replicate test. Field replicates give an indication of how much variability there is in the equipment, sampling techniques, and environment. To perform and record field replicates:

- At the replicate site(s), grab a second sample, as soon as possible after the first, and in the same spot.
- On the Sample Tracking Sheet, write "R" in the "Field Rep?" column on the line for the replicate sample (see sample field sheet at the end of this section).

FIELD PROCEDURE:

For safety purposes, at least two people must go out together to collect grab samples.

1) Fill the car cooler with cubed ice or ice packs provided by county staff. Keep the thermometer in a place where it will be near the outside temperature.
2) Take the portable cooler with you to each site with enough ice to chill the sample(s) until you get them back to the car cooler.
3) When first arriving at the site, hang the thermometer in a shady spot.
4) Collect the sample(s) at each site (gloves are optional, but preferred, and you can use the sampling wand to avoid having to wade in the stream):
   a. Enter the stream downstream of where you plan to sample to avoid contaminating the sample from your boots or stirred-up sediment. Sample at a point within the regular monitoring reach where the stream is flowing, well mixed, and preferably at least 6" deep. (If there is no such place, you may go outside the reach, but note your location on the tracking sheet.) Get as far away from the banks as you can. Choose a spot that appears undisturbed and has little or no sediment stirred up in the water, if possible. (See Figure 1.)

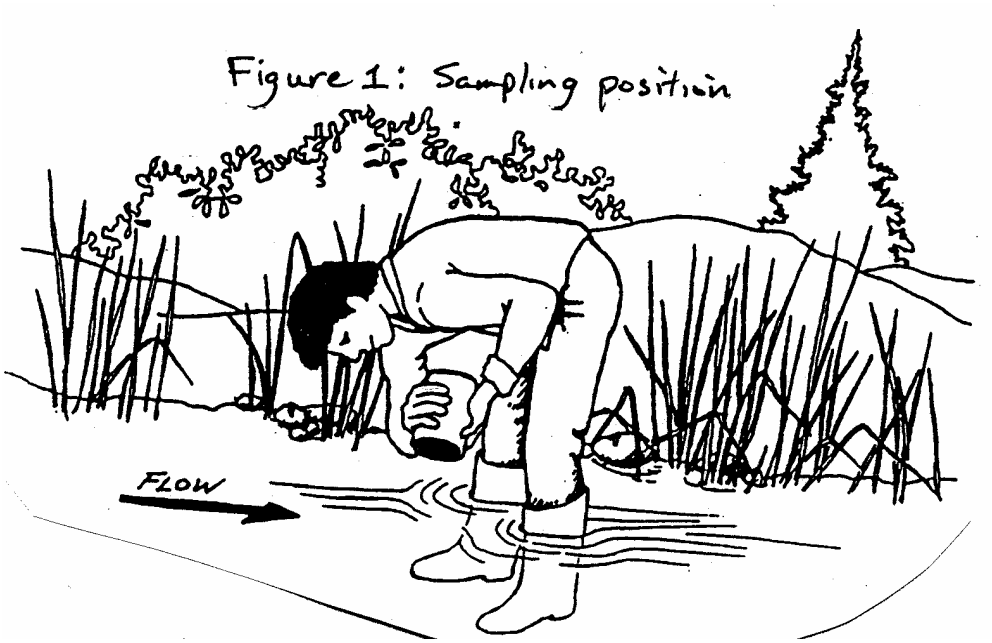


Figure 1: Sampling position
FLOW

b. Uncap the bottle, holding the bottle near the bottom and the cap near the top edge. Do not let anything touch the inside of the cap. Do not set the cap down. Do not rinse the bottle or cap. If the bottle becomes contaminated, discard it.

c. Hold the bottle near its base and plunge it below the water surface with the opening pointing downward. Collect the sample 8-12" below the surface. If the water is shallow, collect midway between the bottom and the surface. (If the water is less than 6" deep, note the depth on the tracking sheet.) Turn the bottle underwater into the current and away from you. In slow-moving stream reaches, push the bottle underneath the surface and away from you in an upstream direction. Take the bottle out of the water when it is filled up to the shoulder. (See Figure 2.) You may attach the bottle to the end of a long stick to collect this sample without disturbing the stream.

    i. If the bottle comes out with the water level below the shoulder, pour out the water, and try again.

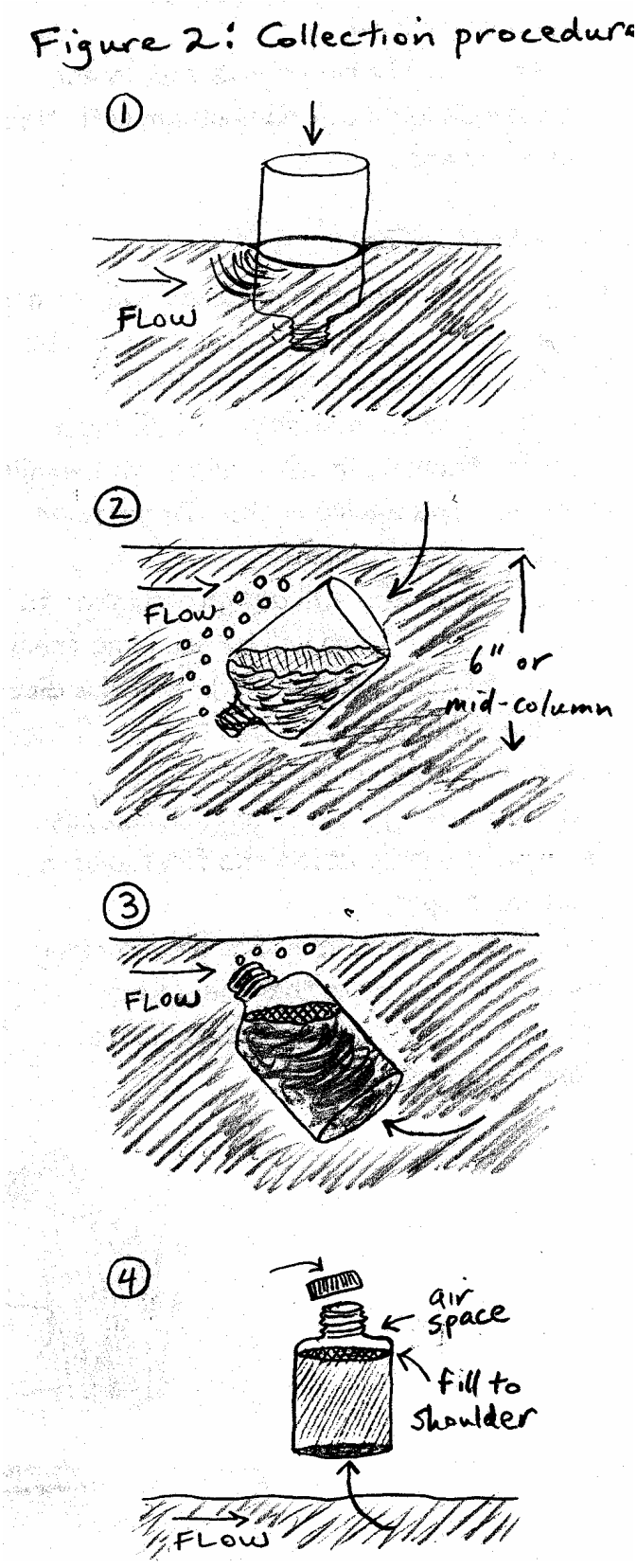
    ii. If the bottle comes out full, recap it, shake, uncap, then quickly flick the bottle until the water level decreases to the shoulder, OR pour out the water and try again.

d. Recap the bottle carefully without touching the inside. ***Mark the bottle*** with the stream name, reach number or location description, and time.

e. Put the bottle in the cooler.

f. If this is a site where you are to take a ***replicate***, repeat the sampling procedure. When you mark the bottle, include a circled "R" after the reach number.

5) At your first sampling site, fill out the date, sampler in charge, and other samplers' names on the Tracking Sheet (see example at end of section). The "Sampler in Charge" is the person ultimately responsible for the data at those sites on that day. Be sure to include all initials.



6) At each site, enter on the tracking sheet:
   a. The stream and site name; if the site is not a regular monitoring reach, describe its location briefly.
   b. "R" if the sample is a field replicate (see discussion above).
   c. The time of sampling.
   d. Sample collector's initials.
   e. The air temperature: hold the thermometer by the upper end in a shady, dry spot until it stabilizes, and record to the nearest °C. *(Remember to take the thermometer back with you!)*
   f. Any noteworthy remarks—e.g., a flock of ducks on the water, abundant leaf litter, strange debris, unusual smells—or problems. NOTE IF THE WATER IS TURBID.
7) If you are taking a ***nutrient sample*** at this site, follow a similar sampling procedure:
   a. Write "Y" in the "nutrient sample?" column on the tracking sheet.
   b. Take a ***replicate*** nutrient sample at each fecal replicate site.
8) Return to the car. Transfer sample bottles to the car cooler.
9) When finished sampling, bring all samples and forms directly to the Water Resource Section office. On your data sheet, enter the time that you turned the samples in.
10) Return the original data sheet and kits to the office.
11) If values are high at a given stream or reach, the team may be asked to return to the field another day for further sampling.

(see attached example Sample Tracking Sheet)

Notes: